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A REVIEW OF *CINARA* SUBGENUS *CINARELLA* (HEMIPTERA : APHIDIDAE)

V. F. EASTOP

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BY
VICTOR FRANK EASTOP

Pp. 1–23; 14 *Text-figures*

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A REVIEW OF *CINARA* SUBGENUS *CINARELLA* (HEMIPTERA : APHIDIDAE)

By V. F. EASTOP

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SYNOPSIS

A key is given for the separation of the viviparous morphs of the species of *Cinarella* and a few other similar species of *Cinara*. References are given to the original descriptions, principal redescriptions, and synonyms of each species. Data on host plants and geographical distribution are summarized and biometric data are tabulated. Where possible, references are given to accounts of the biology of each species.

INTRODUCTION

The purpose of this paper is to provide a key for the identification of the species of *Cinarella* Hille Ris Lambers, 1948 and a lead in to the literature concerning them. Members of *Cinarella* are known from all continents except Australasia and the Antarctic, feed on species of *Pinus* of economic importance and are frequently misidentified. The recent outbreaks in Brazil of *Cinara maritimae*, originally described from France, and of *C. piniformosana*, originally described from Taiwan, indicate the need for a revision of this group of species. Both *C. maritimae* and *C. piniformosana* have been misidentified with *C. pinea* recently and *C. pinea* has also been known as *C. pineti* and *C. pini*.

Hille Ris Lambers (1948 : 275) proposed *Cinarella* as a new name for Börner's (1939 : 76) concept of *Cinara* Curtis, 1835, and used it as a subgenus of *Cinara* to include both *Lachnus pineus* Mordvilko as type and his new species *Cinara excelsae*. References to the original descriptions and type citations of these genus-group names are to be found in Eastop (1972 : 104–106) as are those of *Cinarella* Börner, 1949 nec Hille Ris Lambers, 1948, its replacement name and the other subgenera and synonyms of *Cinara*. *Cinarella* Hille Ris Lambers, 1948, constitutes one of the better defined species-groups of the genus *Cinara*, being characterized by the

absence of a mesosternal tubercle in the apterae viviparae (present in the summer apterae of *Cinara* s. str.) and the elongate first tarsal segments of all morphs: see *Cinara piniformosanus* (Text-figs 7–11, p. 15). The species of *Cinarella* usually bear rather thick body hairs and the apterae tend to have stalked eyes and their third and fourth antennal segments rarely bear rhinaria (often present in the apterae of *Cinara* s. str.). However, alatiform apterae of *Cinarella* may bear rhinaria on the third and fourth antennal segments. As some species of *Cinara* s. str. such as *laricis* have rather elongate first tarsal segments it can be difficult to assign alatae and *Cinarella* is not regarded as more than a subgenus of *Cinara* Curtis.

Cinarella species live only on *Pinus* and with few exceptions (see p. 17) are confined to subsections Sylvestres and Australes of the section *Pinus* (= *Diploxylon*). *Cinarella* are widely distributed; to judge from their host plants, five species originated in the Palaearctic region, three from the Oriental region and two from the Nearctic region. Several of these species have been distributed more widely by commerce. Information about the distribution of *Pinus* has mostly been obtained from Critchfield & Little (1966), Little & Critchfield (1969) and Mirov (1967). References to the principal accounts of *Cinara* were given by Eastop (1972 : 104). Fossel (1970 : 129–190; 1972 : 125–144, 145–156, 185–191) has given accounts of the Austrian fauna. Ehrhardt & Kloft (1962 : 544–546) give details of a method for rearing *Cinara* species in the laboratory.

Existing accounts of *Cinara* deal only with fauna of parts of continents and one of the purposes of the present paper is to provide a key for recognizing species wherever their origin. The alatae viviparae of several species are unknown but as the alatae of *Cinara* are usually similar to their apterae, the following key can be used for alatae as well as for apterae if the rhinarial characters are ignored. In general rostral characters are the same in alatae as in apterae. As alatae with long hind tibia bearing short hairs are rare, the ratio of these measurements for alatae is the lower half of that ratio for apterae. Similarly the ratio of tarsal segments 2 : 1 for alatae tends to be at the upper end of that ratio for apterae.

Key to the apterae viviparae of *Cinarella*

1 Third antennal segment 3·0–3·7 times as long as the maximum diameter of the siphuncular cones and 12–14 times as long as the longest hair borne on the third antennal segment. Hind tibiae about 30–35 times as long as the longest hair borne on them. Fifth antennal segment 0·75–0·90 times as long as the sixth. Fourth rostral segment 2·9–3·0 times as long as the fifth segment and 0·9 to equal in length to the first segment of the hind tarsus. Second segment of hind tarsus 2·0–2·2 times as long as the fourth rostral segment and 1·9–2·1 times as long as the ventral length of the first segment of the hind tarsus. Anterior abdominal segments without scleroites. A rather short-haired species, hairs on third abdominal tergite up to only about 30–35 μm long and longest hairs on hind tibiae about 60 μm long.

lachnirostris (p. 9)

– Third antennal segment 0·8–2·7 times as long as the diameter of the siphuncular cones and 3·5–13·0 times as long as the longest hair borne on the third antennal segment and if more than 10 times as long then the fourth

rostral segment is 1·2–1·8 times as long as the first segment of the hind tarsus. Hind tibiae either 9–28 or 45–50 times as long as the longest hair borne on them. Fifth antennal segment 1·0–1·7 times as long as the sixth. Fourth rostral segment 1·5–2·6 times as long as the fifth rostral segment 2

2 (1) A rather short-haired species (Text-fig. 2), the longest hairs on the third abdominal tergite about 35 μm long. The hind tibiae are 3·7–4·2 mm long and 45–50 times as long as the longest hair borne on them. Third antennal segment (Text-fig. 1) about 12–13 times as long as the longest hair borne on it. Processus terminalis often bearing 5 subapical hairs. ***formosana*** (p. 8)

– The longest hairs on the third abdominal tergite usually 70–200 μm long, if only 35–65 μm long (*schimitischeki*) then hind tibiae 2·2–3·0 mm long and 15–27 times as long as the longest hair borne on them. Third antennal segment usually 3·2–9·3 times as long as the longest hair borne on it but 9·4–12·0 times as long in *schimitsheki* (see previous character). Most species with only 4 subapical hairs on the processus terminalis but several species 5 or 6 subapical hairs 3

3 (2) Longest hairs on third abdominal tergite 35–100 μm long and evidently shorter than the longest hairs, 100–150 μm, borne on the hind tibiae. Hairs on abdominal tergites 1–6 arising from small dark scleroites about 20–25 μm in diameter (Text-figs 12, 13). Third antennal segment 5·9–12·0 times as long as the longest hair borne on it. Hind tibiae dark, mostly black but slightly paler at the proximal one-third and 15–27 times as long as the longest hairs borne on them. Second segment of hind tarsus 0·9–1·2 times as long as the fourth rostral segment which is 1·4–1·8 times as long as the first segment of the hind tarsus. Eighth abdominal tergite bearing 27–60 hairs on a transverse dark band which is almost or completely broken in the mid dorsal line . . . . . ***schimitscheki*** (p. 14)

– Longest hairs on third abdominal tergites 70–210 μm long and if less than 110 μm long then usually with some arising from larger scleroites with a diameter of 50–77 μm or more. Third antennal segment 3·2–9·3 times as long as the longest hair borne on it and if more than 5·5 times as long then either the second segment of the hind tarsus is 1·5–1·8 times as long as the fourth rostral segment or the fourth rostral segment is 0·8–1·2 times as long as the first segment of the hind tarsus or the hairs on the third abdominal tergites are up to 130–180 μm long and evidently longer than those of up to 70–130 μm long on the hind tibiae. Eighth abdominal tergite bearing 13–28 hairs. 4

4 (3) Fourth rostral segment 310–360 μm long and 2·4–2·6 times as long as the fifth rostral segment and 1·5–1·8 times as long as the first segment of the hind tarsus. Second segment of hind tarsus 0·9–1·1 times as long as the fourth rostral segment. Hind tibiae 9–11 times as long as the longest hair borne on them. Scleroites small and pigmented bar on eighth abdominal tergite broken medianly. . . . . ***atrotibialis*** (p. 7)

– Fourth rostral segment 150–300 μm long, 1·7–2·4 times as long as the fifth segment and 0·7–1·7 times as long as the first segment of the hind tarsus, but if more than 1·5 times (*maritimae*) then hind tibiae 16–26 times as long as the longest hair borne on them. Second segment of hind tarsus 1·1–2·4 times as long as the fourth rostral segment. Hind tibiae 11–28 times as long as the longest hair borne on them. 5

5 (4) Shorter-haired species: longest hairs on abdominal tergites 2–5 only about 70–80 μm long and when arising from scleroites these have a greatest diameter of less than 75 μm. Third antennal segment 6–15 times as long as the longest hairs borne on it. Hind tibiae with a pale area at about the basal one-quarter.

Second segment of hind tarsus only 310–370 μm long yet 1·5–1·8 times as long as the fourth rostral segment (190–230 μm) 6

– Longer-haired species: longest hairs on abdominal tergites 2–5 from 80–200 μm long and if less than 120 μm then either some arise from scleroites with a maximum diameter of 75–180 μm (*pinea*), or the hind tibiae are black (*piniformosana*). Third antennal segment 3·5–7·5 times as long as the longest hair borne on it. Second segment of hind tarsus 1·1–2·4 times as long as the fourth rostral segment but when 1·5–1·8 times, the second segment of the hind tarsi usually exceeds 370 μm in length except in *pergandei* in which the third antennal segment is only 3·5–4·5 times as long as the longest hair borne on it. 7

6 (5) Second segment of hind tarsus 1·5–1·9 times as long as the first segment. Fourth rostral segment 1·0–1·3 times as long as the first segment of the hind tarsus. Third antennal segment 6–10 times as long as the longest hair borne on it. Diameter of siphuncular cone 4·0–5·5 times that of its porus. Processus terminalis bearing 4 or 5 subapical setae. Some of the dorsal abdominal hairs arising from scleroites with a maximum diameter of up to 65–75 μm. . . . . ***piniphila*** (p. 14)

– Second segment of hind tarsus 2·1–2·6 times as long as the first segment. Fourth rostral segment 1·4–1·6 times as long as the first segment of the hind tarsus. Third antennal segment 10–15 times as long as the longest hair borne on it. Diameter of siphuncular cone only 2·3–3·5 that of its porus. Processus terminalis bearing 5–7 subapical setae. Scleroites not evident. ***hyperophila*** (p. 8)

7 (5) Largest scleroites on the second to fifth abdominal tergites with a greatest diameter of 75–300 μm. Second antennal segments bearing 5–10 hairs and base of sixth antennal segment bearing 2–8 hairs. Processus terminalis usually bearing 4, exceptionally 3 or 5 subapical setae. Second segment of hind tarsus 1·3–2·2 times as long as the fourth rostral segment which is often 0·8–1·2 but sometimes 1·2–1·4 times as long as the first segment of the hind tarsus. Hind tibiae usually 11–15 but sometimes 15–20 times as long as the longest hair borne on them. 8

– Largest scleroites on abdominal tergites 2–5 with a maximum diameter of 25–75 μm. Second antennal segments bearing 6–14 hairs and base of sixth antennal segment bearing 6–12 hairs. Species with 4, 5 or 6 subapical setae on the processus terminalis. Second segment of hind tarsus 0·9–1·6 times as long as the fourth rostral segment which is 1·2–1·8 times as long as the first segment of the hind tarsus. Hind tibiae usually 15–26 but sometimes only 12–15 times as long as the longest hair borne on them. . . 10

8 (7) Fourth rostral segment 1·2–1·4 times as long as first segment of hind tarsus and 2·0–2·4 times as long as the fifth rostral segment. Second segment of hind tarsus 1·3–1·6 times as long as the fourth rostral segment and 1·6–2·1 times as long as the first segment of the hind tarsus. Many of the hairs on the seventh abdominal tergite arising from a fenestrated transverse band. First tarsal segments without dorsal hairs. . . . . ***neubergi*** (p. 11)

– Fourth rostral segment 0·7–1·2 times as long as the first segment of the hind tarsus and 1·6–2·3 times as long as the fifth rostral segment. Second segment of hind tarsus 1·4–2·2 times as long as the fourth rostral segment and 1·4–1·9 times as long as the first segment of the hind tarsus. Hairs of the seventh abdominal tergite usually arising from individual large scleroites which only rarely anastomose to form a much fenestrated transverse dark band. 9

9 (8) First tarsal segments usually bearing 1 or 2 dorsal hairs. Tibiae usually pale, sometimes dusky over the distal one-third. Most hairs on tergites 1–7 arising from more similarly sized and often transversely elongate scleroites

(Text-fig. 6) of from 75 × 40 μm to 180–50 μm diameter with few if any scleroites of about 14 μm diameter. Fifth abdominal tergite bearing 28–49 hairs between the siphunculi. Transverse dark band on eighth abdominal tergite often complete, broken in the mid line in about one-third of the specimens studied. . . . . ***pinea*** (p. 12)

– First tarsal segments without dorsal hairs. Tibiae usually black, sometimes the very bases of the fore and mid tibiae and the basal third of the hind tibia are paler. Hairs on abdominal tergites 1–7 arising from roundish scleroites of very different sizes, most of the scleroites are little more than pigmented hair bases of 10–15 μm diameter while others on each segment have a diameter of 75–100 μm. Fifth abdominal tergite bearing 50–110 hairs between the siphunculi. Transverse dark band on eighth abdominal tergite usually broken in the mid line, the two parts being linked by a narrow band of pigmentation occasionally. . . . . ***pergandei*** (p. 12)

10 (7) Second segment of hind tarsus (Text-fig. 11) 1·7–2·4 times as long as the fourth rostral segment (Text-fig. 10) which is 150–205 μm long and 0·8–1·2 times as long as the first segment of the hind tarsus. The tibiae are black. Eighth abdominal tergite bearing a broad transverse band from which the hairs arise (Text-fig. 7). Hairs on the seventh abdominal tergite arising from large scleroites which in heavily pigmented specimens anastomose to form a fenestrated transverse band. . . . . ***piniformosana*** (p. 13)

– Second segment of hind tarsus 1·1–1·6 times as long as the fourth rostral segment which is 250–300 μm long and 1·2–1·7 times as long as the first segment of the hind tarsus. Hind tibia with a pale area at about the basal one-third. Fifth abdominal tergite bearing 30–60 hairs between the siphunculi (Text-fig. 4). Eighth abdominal tergite bearing a dark transverse band which is sometimes broken medianly. 11

11 (10) Hind tibiae 16–27 times as long as the longest hair (70–130 μm) borne on them. Third antennal segment (Text-fig. 3) 4·0–7·4 times as long as the longest hair borne on it and 1·5–2·0 times as long as the fourth rostral segment. Second antennal segment bearing 7–11 hairs, base of sixth antennal segment bearing 7–12 hairs and processus terminalis bearing 4 or 5, rarely 3 or 6, subapical setae. First tarsal segments with or without dorsal hairs. Seventh and eighth abdominal tergites both bearing dark unbroken transverse bands, that on the seventh tergite being fenestrated in lightly pigmented specimens. . . . . ***maritimae*** (p. 10)

– Hind tibiae 12–15 times as long as the longest hair (150–175 μm) borne on them. Third antennal segment 3·5–5·0 times as long as the longest hair borne on it and usually 2·0–2·4 times as long as the fourth rostral segment. Second antennal segment bearing 6–9 hairs, base of sixth antennal segment bearing 6–7 hairs and processus terminalis bearing 4, rarely 3, subapical setae. First tarsal segments without dorsal hairs. Pigmented band of eighth abdominal segment broken in the mid dorsal line and seventh abdominal segment with only scleroites. . . . . ***watsoni*** (p. 17)

THE SPECIES OF *CINARELLA*

Cinara atrotibialis David & Rajasingh

Cinara atrotibialis David & Rajasingh, 1968 : 103–105. [Type, Madras Christian College; INDIA: Assam, Shillong, *Pinus* sp., 19.v.1967.]
Cinara sp., Robinson, 1972 : 604.
Cinara khasyae Robinson, 1972 : 1925–1927.

SPECIMENS STUDIED.

THAILAND: Mt Suthep, *Pinus khasya*, 26.iii.1970, 2 apterae (paratypes of *khasyae*). INDIA: Assam, Shillong, *Pinus insularis*, 10.i.1960, 2 immature specimens (*A. K. G* [*hosh*].); Himachal Pradesh, Simla, *Pinus* sp., i.1970, immature specimen (*L. K. Ghosh*). PHILIPPINE Is.: Baguio Mt Prov., *Pinus insularis*, 24.vi.1969, 1 aptera (*V. J. Calilung*).

HOST-PLANTS. *Pinus insularis* (= *khasya*).

DISTRIBUTION. India (Assam, Himachal Pradesh), Thailand, Philippine Is.

NOTES. The single specimen seen from the Philippine Is. had a body length of only 2·7 mm but the fourth rostral segment was .264 μm long. The relationship between body length, fourth rostral segment length and temperature during development in aphids is complex but it is possible that the Philippine specimen represents a distinct subspecies and that *khasyae* is also subspecifically distinct. *Pinus insularis* consists of geographically isolated populations, those on the Asian mainland being known as *P. khasya* and those in the Philippine Is. as *P. insularis*. There is unlikely to be much gene flow between the aphid populations of the Himalayas, Thai mountains and Philippine Is.

Cinara formosana (Takahashi)

(Text-figs 1, 2)

Dilachnus sp., Takahashi, 1923 : 46.
Dilachnus formosanus Takahashi, 1924 : 73–74. [Type, Taiwan Agricultural Research Institute; TAIWAN: 'Formosa', Taihoko, Shinten, *Pinus* sp., 13.x.1923, attacking the shoot.]
[*Panimerus piniformosanus* (Takahashi) Takahashi, 1928 : 28 nec 1921. Misidentification.]
Neochmosis formosanus (Takahashi) Takahashi, 1930 : 325.
Cinara formosana (Takahashi) Takahashi, 1931 : 23; 1936 : 493; Tseng & Tao, 1936 : 123; Tao, 1962 : 44–45; Higuchi & Miyazaki, 1969 : 31; Inouye, 1970 : 67–68.
Panimerus kiangsiensis Lou, 1935 : 37–42. [Types unknown; CHINA: Kiang-si, Lou-chan, 25.iv.1930, numerous alatae, Yian, Wei-i.]

SPECIMEN STUDIED.

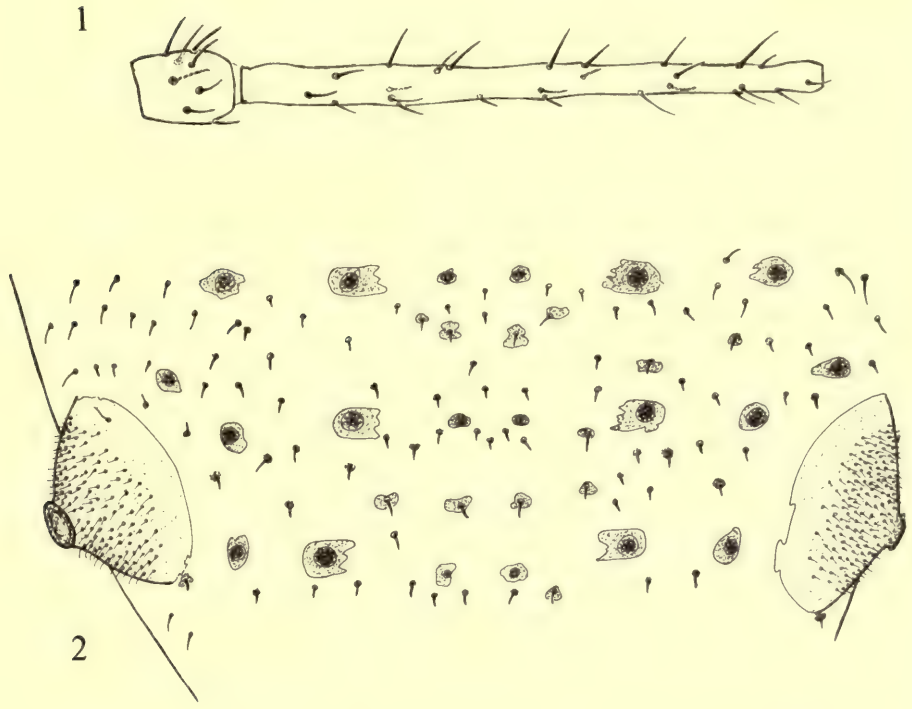
CHINA: Fukien, 1 aptera, M. S. Yang coll. (no. 5319) (*R. Takahashi*).

HOST-PLANTS. Recorded from *Pinus thunbergii* and *P. densiflora* and more rarely from *P. luchuensis* and *P. massoniana* of the subsection Sylvestres.

DISTRIBUTION. Seen from China, originally described from Taiwan (Formosa) and also recorded from Japan.

Cinara hyperophila (Koch)

Lachnus hyperophilus Koch, 1855 : 232–234. [Types unknown AUSTRIA: Königswiessen, *Pinus sylvestris*, May, June, October, November.]
Lachnus pineus var. *hyperophilus* Koch, Mordvilko, 1894/5 : 102.
Cinara (*Subcinara*) *hyperophila* (Koch) Pasek, 1954 : 139–140; Heinze, 1962 : 156, 157.
Cinara hyperophila (Koch) Szelegiewicz, 1962 : 82; Pintera 1966 : 289, 290.



FIGS 1, 2. *Cinara formosana*, aptera vivipara. 1, second and third antennal segments, × 100. 2, fourth and fifth abdominal tergites, × 40.

SPECIMENS STUDIED.

POLAND: Otwock, *Pinus silvestris*, 4.vii.1887, 2 juveniles, A. Mordvilko coll. (*H. Szelegiewicz*).

HOST-PLANT. *Pinus sylvestris*.

DISTRIBUTION. Austria, Czechoslovakia and Poland. The record from Sweden appears to have been based on a fundatrix of *Cinara pini* (L.).

NOTES. A little known central European species of which no adults have been seen by the present author. It was included in the key from the data provided by Pintera (1966 : 290). Koch (1855 : 234) found numerous males in April and May on the small trees from which he had collected oviparae in September and October. This suggests that *hyperophila* was not adapted to conditions at Königswiessen. As *hyperophila* survives at not much higher latitudes in Czechoslovakia and Poland the small trees Koch studied in Austria may have been growing in a sheltered position and in receipt of supplementary light and heat during the winter.

Cinara lachnirostris Hille Ris Lambers

Cinara lachnirostris Hille Ris Lambers, 1966 : 201–203. [Type, Hille Ris Lambers collection, Bennekom, Netherlands; data as for specimen studied.]

SPECIMEN STUDIED.

PAKISTAN: Murree, 2250 m, *Pinus* ? *excelsa*, 3.vii.1964, 1 aptera (*D. Hille Ris Lambers*).

HOST-PLANT. Probably *Pinus wallichiana* (= *excelsa* Wallich).

DISTRIBUTION. Pakistan (Murree, 2250 m).

NOTES. Probably not really a *Cinarella* but the first tarsal segments are long enough to take it to *Cinarella* in some keys.

Cinara maritimae (Dufour)

(Text-figs 3, 4)

Aphis pini subsp. *maritimae* Dufour, 1833 : 243–245. [Types unknown; presumably FRANCE: 'du pin maritime'.]

[*Cinara pineti* (F.) Blanchard, 1939 : 869. Misidentification.]

Cinara excelsae Hille Ris Lambers, 1948 : 273–274. [Types Hille Ris Lambers collection; 'PALESTINE': Beth-Hakerem, *Pinus excelsa*, 29.iv.1946; ISRAEL: Jerusalem, 26.iv.1946.] Bodenheimer & Swirsky, 1957 : 245.

Cinara (*Cinarella*) *excelsae* Hille Ris Lambers; Çanakçioglu, 1966 : 138.

Cinara maritimae (Dufour) Eastop & Hille Ris Lambers, 1976 : 135.

SPECIMENS STUDIED.

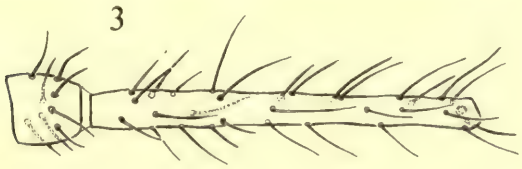
CYPRUS: Nicosia, pine, 19.iii.1968, 5 apterae, G. P. Georghiou coll. (*R. C. Dickson*). FRANCE: Massif de l'Esterelle, *Pinus* ? *maritima*, 31.viii.1959, 2 apterae, 1 alata (*D. Hille Ris Lambers*); Brittany, La Trinité sur Mer, *P.* ? *maritima*, 25.vii–15.viii.1968, 6 apt., 1 al. (V.F.E.). MOROCCO: Rabat, *P. maritima*, i.1928, 6 apt., 1 al. (*J. Mimeur*) F. V. Theobald colln. ISRAEL: Ein-Hsishofeth, *Pinus* sp., 2 apt.; Jerusalem, 23.iv.1946, 2 apt. (*E. Swirski*). TURKEY: Aydin-Mazon ormani, 650 m, 18.vii.1964, 2 apt. (*H. Çanakçioglu*).

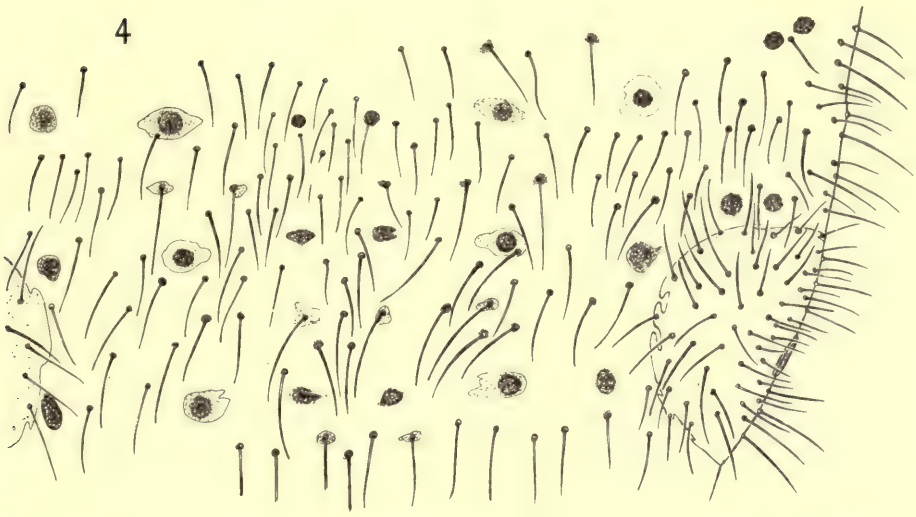
BRAZIL: S. P., Campinas, suction trap, iv–vi.1968, 5 al. (*C. L. Costa*); S.P., *Pinus* sp., 21.v.1969, 9 apt. 3 al. (*C.L.C.*); S.P., Piricicaba, *Pinus elliottii*, 25–26.vi.1968, 5 apt. 6 al.; 21.v.1969, 5 apt. 5 al. (*C.L.C.*); *P. caribaea bahamensis*, 25.viii.71, 11 apt. 2 al., A. Zamith coll. (*F. Mariconi*); R. S., Sanata Maria, *Pinus* sp., 7 apt. 2 al., (*D. Link*); R.S., Sao Sepe, *P. elliottii*, 22.xi.72, 4 apt. 1 al. (*V.F.E.*). CHILE: Concepción, 28.i.1961, 2 al. (*D. Hille Ris Lambers*).

HOST-PLANTS. Seen from members of the *Pinus halepensis* (= *maritima* Lamarck)/*pinaster* (= *maritima* Poiret) group from which it was originally described and recorded from *P. thunbergii* and possibly *P. densiflora* also of the subsection Silvestres. Specimens have also been seen from *P. caribaea* and *P. elliottii* of the subsection Australes and are also recorded from introduced *P. canariensis* (subsection Canariense) and *P. radiata* (as *insignis*, subsection Oocarpae) in Israel (Swirski, 1963 : 1).

DISTRIBUTION. Seen from Cyprus, France, Morocco, Israel, Turkey, Brazil and Chile and probably also occurring in Argentina (Blanchard, 1939 : 869, as *pineti* F.).

NOTES. Although described more than 140 years ago, widespread in the





FIGS 3, 4. *Cinara maritimae*, aptera vivipara. 3, second and third antennal segments × 100. 4, fourth and fifth abdominal tergites, × 70.

Mediterranean region, extending as far north as Brittany on pines planted for coastal protection and also occurring in South America, *C. maritimae* is rarely mentioned in entomological literature. *C. maritimae* has probably been confused with *C. pinea* which is very common on *Pinus sylvestris* in Europe but in which the fourth rostral segment is only 0·8–1·2 times as long as the second segment of the hind tarsus (1·3–1·7 in *maritimae*).

Cinara neubergi (Arnhart)

Lachnus neubergi Arnhart, 1930 : 392–398. [Types unknown; AUSTRIA: Neuberg a. d. Mürz, July 1927/9, twigs of *Pinus montana*.]

Cinara neubergi (Arnhart) Heinze, 1962 : 158; Szelegiewicz, 1962 : 69, 86; Pintera, 1966 : 286–287; Fossel, 1970 : 164, 170, 176, 182.

SPECIMENS STUDIED.

ITALY: Valle Campo, 2000 m, *Pinus mugo pumilio*, 2.ix.1975, 2 apterae (*A. Binazzi*). SWITZERLAND: Grimmels, 2100 m, *P. mugo*, 4.viii.1956, 1 apt., W. Eglin coll. (*D. Hille Ris Lambers*).

HOST-PLANT. *Pinus mugo* (= *montana* Miller nec Lamarck).

DISTRIBUTION. Originally described from the Austrian Alps, seen from Italy and Switzerland and also recorded from Bulgaria, Germany and U.S.S.R. (Ukraine).

NOTES. Braun (1930 : 485) thought that *neubergi* was a variety of *C. pinea*.

Cinara pergandei (Wilson)

Lachniella pergandei Wilson, 1919 : 46–47. [Types, USNM; U.S.A.: Va, *Pinus inops*, June, 1903 & 1905, T. Pergande coll.]
Cinara longispinosa Tissot, 1932 : 4–5. [Type, Fla agric. expt. Stn; U.S.A.: Fla, Gainsville, *Pinus taeda*, 3.viii.1929, A. N. Tissot coll.]
Cinara pergandei (Wilson) Palmer, 1945 : 451–452; Pepper & Tissot, 1973 : 75–83.

SPECIMENS STUDIED.

CANADA: Manitoba, Winnipeg, glasshouse, 21.iii.1962, 6 apt., *Pinus banksiana*, greenhouse, 2.x.1961, 1 al. (*G. A. Bradley*). U.S.A.: Fla, Gainsville, *Pinus glabra*, 11.xii.1964, 1 apt. (*J. O. Pepper & A. N. Tissot*); Iowa, Ames, jack pine, 22.vii.1924, 5 juveniles (*F. C. Hottes*); N.C., Toxawdry, *Pinus echinata*, 27.viii.1957, 1 apt. (*W. R. Richards*).

HOST-PLANTS. Originally described from *Pinus inops* (= *virginiana*) and seen from *P. banksiana* also of the subsection Contortae. *C. longispina* was originally described from *P. taeda*, has been seen from *P. echinata* and *P. glabra* and has also been recorded from *P. clausa* and *P. rigida* all of the subsection Australes. There is also a single record from *P. tanyosho* (= *densiflora*) of the subsection Sylvestres.

NOTES. Bradley (1951 : 334) gives an account of the biology and Bradley & Hincks (1968 : 42, 45) give accounts of parasites and attendant ants.

Cinara pinea (Mordvilko)

(Text-figs 5, 6)

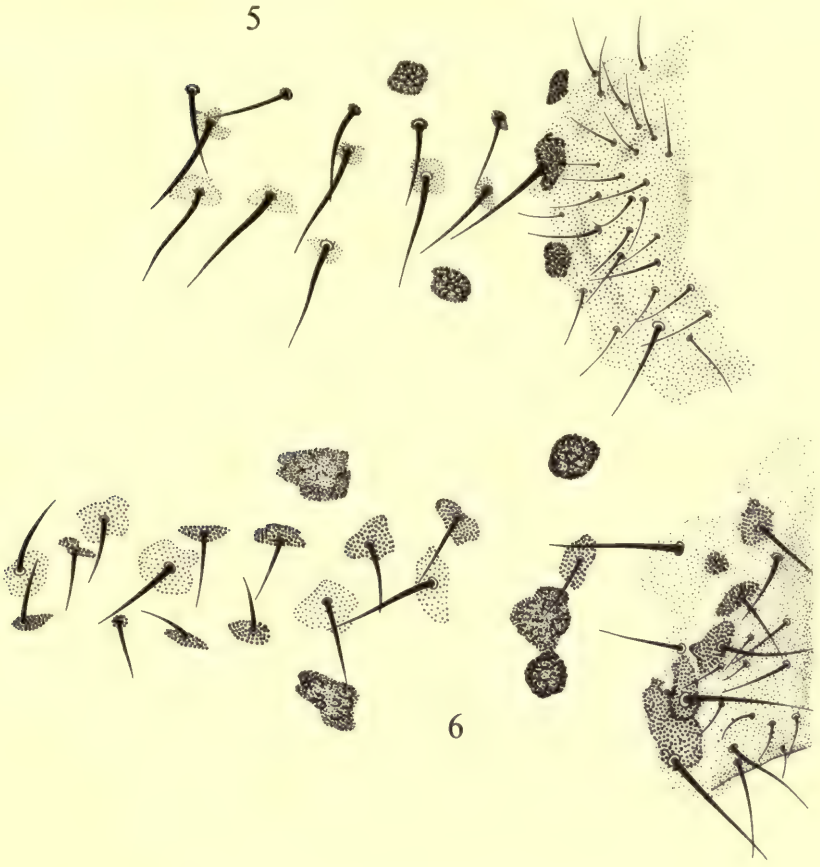
Lachnus pineus Mordvilko, 1894/5 : 75–77, 80, 82, 94, 100; 1895 : 102, 126–130.
Lachniella inoptis Wilson, 1919 : 18–19.
Cinara pinea (Mordvilko) Börner, 1932 : 569 and many later authors. [See Eastop, 1972 : 156–160; Fossel, 1970 : 164, 170, 176, 182; 1972 : 125–144; Pepper & Tissot, 1973 : 84–93.]
Cinara diversiseta Börner, 1952 : 41, 241.
Cinara kaltenbachi Hottes, 1954 : 170, footnote.

SPECIMENS STUDIED.

76 apterae viviparae, 40 alatae viviparae, see Eastop, 1972 : 157–159 for details.

HOST-PLANTS. *Pinus sylvestris* and occasionally other *Pinus* spp. (see Eastop, 1972 : 159 for details).

DISTRIBUTION. Europe, from Britain to U.S.S.R. (Caucasus) and Sweden to Italy (see Eastop, 1972 : 161 for details) and introduced to North America. Japanese and other Oriental records may apply to other species, mostly *C. piniformosana*.



FIGS 5, 6. *Cinara pinea*, right siphunculus and part of fifth abdominal tergite, × 87. 5, alata. 6, aptera.

NOTES. Fossel (1972 : 125–144) describes two forms of *C. pinea* from Austria which may be another expression of the polymorphism found in British alatae (Eastop, 1972 : 159–160). Scheurer (1971) found that *C. pinea* was little affected by ants, unlike *C. pini* and *C. escherichi* (= *nuda*) which were dependant on them. Pechhacker (1974 : 42–45) has discussed the effect of pest control operations in forests on populations of *Cinara pinea* and other aphids and ants. The dorsal abdominal scleroites tend to be smaller in the alatae than in the apterae (Text-figs 5, 6).

Cinara piniformosana (Takahashi)

(Text-figs 7–11)

[*Lachnus pini* (L.) Maki, 1915 : 35. Misidentification.]
Dilachnus sp., Takahashi, 1921 : 82.

Dilachnus piniformosana Takahashi, 1923 : 47; Hori, 1929 : 58.
Neochmosis piniformosanus (Takahashi) Takahashi, 1930 : 325.
[*Cinara pineti* (Koch) Takahashi, 1931 : 22–23; Tao, 1962 : 35–36; Paik, 1965 : 17–18. Misidentification.]
[*Cinara formosana* (Takahashi) Inouye, 1939 : 141–142; 1956 : 215–216; Moritsu, 1956 : 338. Misidentification.]
Cinara piniformosana (Takahashi) Inouye, 1970 : 63–65.

SPECIMENS STUDIED.

JAPAN: Honshu, Kyoto, *Pinus* sp., 6.iv.1964, 3 apterae (*H. Takada*). BRAZIL: S.P., Campinas, water traps, v–vi, 1968, 1 al. (*C. L. Costa*); S.P., Suzano, *Pinus densiflora* + *thunbergii*, 27.viii.1971, 3 apt., *Pinus* sp., x.1971, 5 apt., 3 al., S.P., Carlos, *Pinus* sp., ? 1971, 9 apt. (*F. Mariconi*).

HOST-PLANTS. Usual host *Pinus densiflora* and also seen from *P. thunbergii* and recorded from *P. sylvestris*, *P. luchuensis* and *P. massoniana*, all of the subsection Sylvestres.

DISTRIBUTION. Seen from Japan and Brazil, originally described from Taiwan (Formosa) and also recorded from Korea.

BIOLOGY. Attended by various ants and overwintering as eggs in Japan where the males are alate (Inouye, 1970 : 64).

NOTES. Paik (1972 : 146–147) illustrates a species with very short first tarsal segments, a very hairy fourth rostral segment and a short fifth rostral segment under the name *C. piniformosana* (Takahashi, 1929) which does not seem to be either *C. piniformosana* (Takahashi, 1923) or *C. formosana* (Takahashi, 1924).

Cinara piniphila (Ratzeburg)

Aphis piniphila Ratzeburg, 1844 : 219–220, pl. 2, fig. 5. [Types unknown; locality not stated, presumably GERMANY: needles and young twigs of *Pinus sylvestris*.]
Lachnus pineus var. *curtipilosa* Mordvilko, 1895 : 130–132. [Types unknown; POLAND: Kielce, June, 1893.]
Eulachnus mingazzinii del Guercio, 1909 : 326–329. [Types unknown; ITALY: Florence, *Pinus sylvestris*.]
Cinara piniphila (Ratzeburg) Börner, 1952 : 41; Szelegiewicz, 1962 : 86–87; Pintera, 1966 : 288–289.

SPECIMEN STUDIED.

GERMANY: Vogelherd Wald, *Pinus sylvestris*, ii.v.1936, 1 aptera (*K. Heinze*).

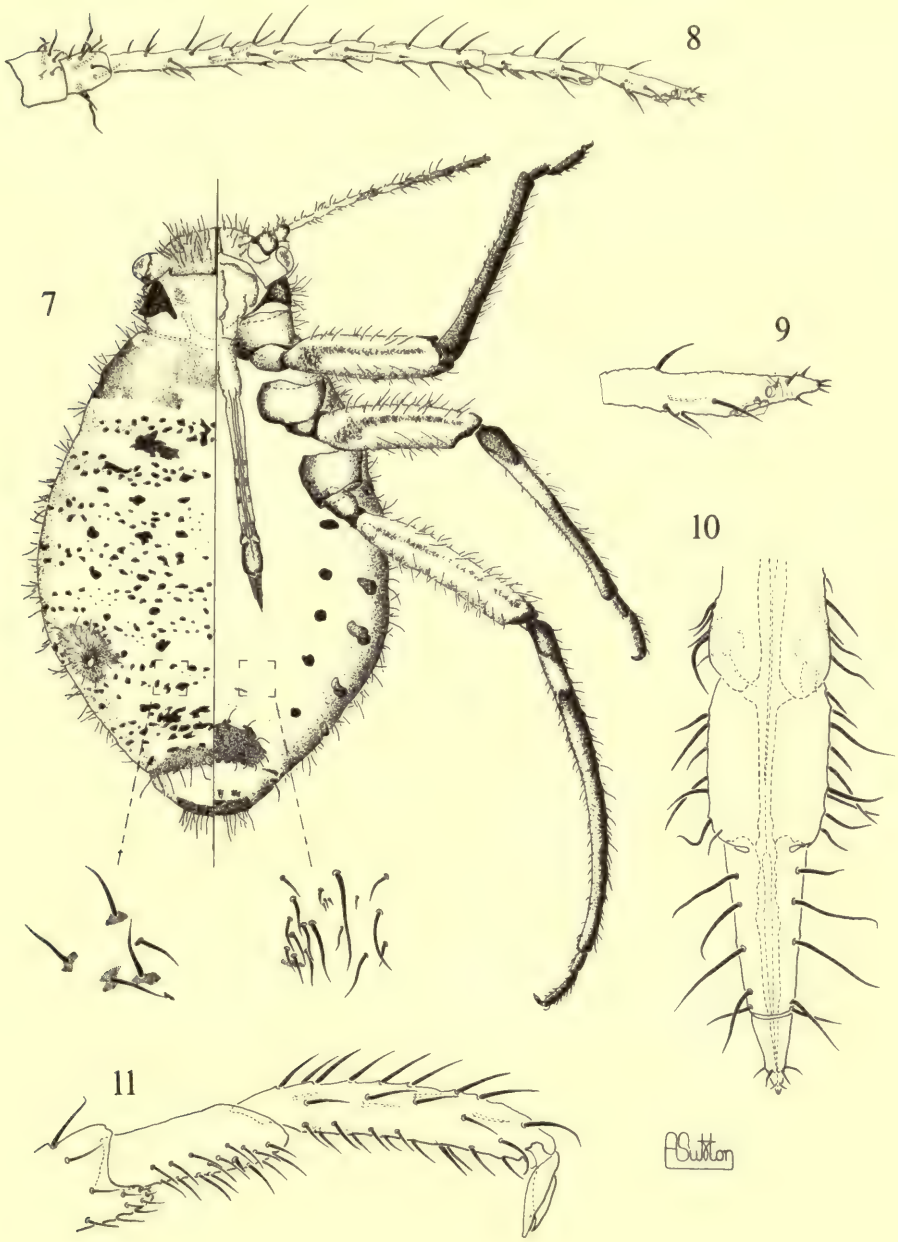
HOST-PLANT. *Pinus sylvestris*.

DISTRIBUTION. Seen and originally described from Germany and subsequently recorded from Austria, Czechoslovakia, Italy and Poland.

Cinara schimitscheki Börner

(Text-figs 12–14)

Cinara schimitscheki Börner, 1940 : 1. [Types, Deutsches Entomologisches Institut, Eberswalde; GERMANY: Naumburg, twig ends of *Pinus austriaca*.] Tremblay & Micieli de Biase, 1970 : 210–213 and many others, see Eastop, 1972 : 164.

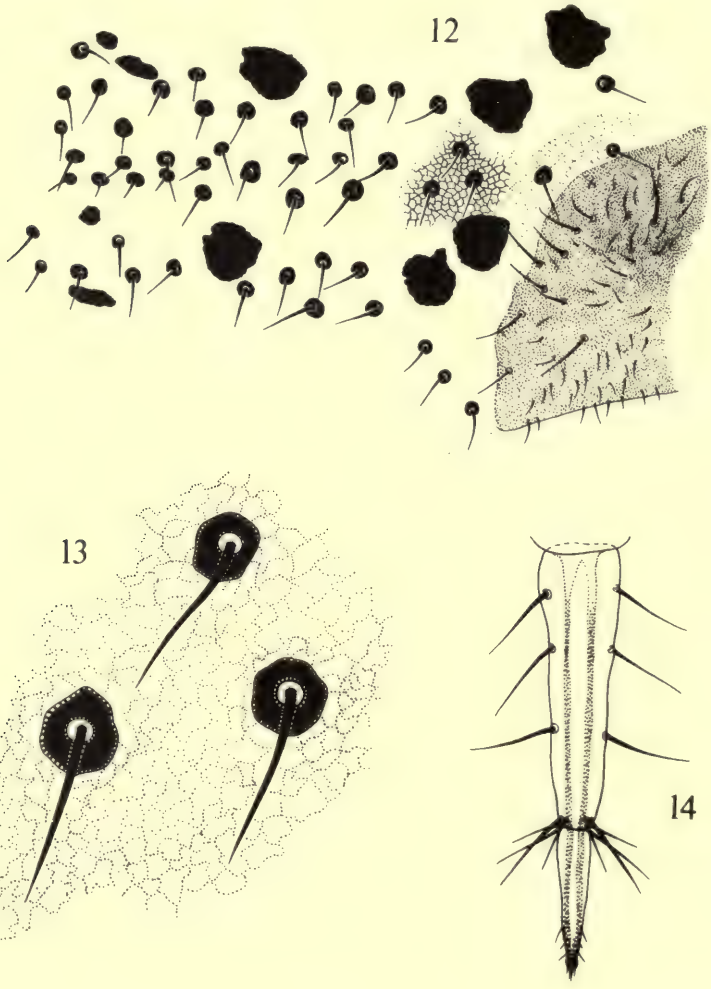


FIGS 7–11. *Cinara piniformosana*, aptera vivipara. 7, whole insect, × 20. 8, antenna, × 55. 9, sixth antennal segment, × 110. 10, rostrum, apex of second to fifth segment, × 110. 11, hind tarsus, × 110.

Cinara kosarowi Tashev, 1962 : 207–210. [Types, University of Sofia; BULGARIA: *Pinus leucodermis*, 9.vii.1960].

SPECIMENS STUDIED.

In addition to those listed by Eastop (1972 : 165). GREAT BRITAIN: England, Surrey, Kew Gardens, *Pinus nigra*, 30.vi.1965, 4 juveniles; 10.vii.1971, 1 apt.; 17.vi.1972, 2 apt. (*V.F.E.*). ITALY: Campini near Florence, *Pinus pinea*, 21.v.1973, numerous juveniles (*A. Binazzi*).



FIGS 12–14. *Cinara schimitsheki*, aptera vivipara. 12, part of right side of fifth abdominal tergite, × 87. 13, enlargement of part of 12, × 450. 14, fourth and fifth rostral segments, × 175.

HOST-PLANTS. Usually on *Pinus nigra* including several of its varieties and also recorded from *P. leucodermis* and *P. mugho* subsp. *mughus* of the subsection Sylvestres. A large sample of immature specimens has been seen from *P. pinea* of the subsection Pinea.

DISTRIBUTION. Europe, England to the U.S.S.R. (Crimea) and Turkey, but not Baltic or Scandinavian, see Eastop, 1972 : 165.

BIOLOGY. Lives singly on the young shoots during May and June but not evident after early July when it is said by Pašek (1954 : 175) to go under the bark of older branches.

Cinara watsoni Tissot

Cinara watsoni Tissot, 1939 : 43; Pepper & Tissot, 1973 : 132–140.

SPECIMENS STUDIED.

U.S.A.: Fla, Gainsville, *Pinus taeda*, 5.iv.1933, 1 aptera (paratype) (*A. N. Tissot*); 7.iii.1965, 1 al. (*J. O. Pepper*); Pennsylvania, Philipsburg, Blk Mash Dam, *Pinus rigida*, 1.viii.1954, 4 apt. (*J.O.P.*); Scotia, *P. rigida*, 15.viii.1964, 1 al. (*J.O.P. & A.N.T.*).

HOST-PLANTS. Seen from *Pinus rigida* and *P. taeda* and also recorded from *P. echinata, elliotti, glabra, palustris* and *serotina*, all of the subsection Australes.

DISTRIBUTION. U.S.A., widespread over about the eastern third, see Pepper & Tissot, 1973 : 139.

NOTES. Brooks & Warren (1964 : 310–316) give an account of the biology of *C. watsoni* and Werner & Clark (1969 : 436–437) of control measures.

HOST PLANTS OF *CINARELLA*

Pinus L.

Section Strobus (= subg. Haploxylon or section A. Haploxylon of Shaw, 1914).
Subsection Strobi (= group Flexiles of Shaw).
P. peuce/wallichiana group including excelsa and griffithii.
Cinara lachnirostris

Section 4 Pinea
Subsection Canariense
P. canariensis
Cinara maritimae

Subsection Pineae
P. pinea
Cinara schimitscheki

Section 5 Pinus (= subg. Diploxylon or section B. Diploxylon of Shaw or subg. Eupitys of Rehder, 1949)
Subsection Sylvestres (= Laricones of Shaw)

TABLE

Biometric data for the

	Host plant	Number of specimens	Body length mm	Diameter of siphuncular cone	Diameter of scleroites on abdominal tergites 2–5	Length in μm of antennal segments III	IV
lachnirostris	*wallichiana*	1	2·4–3·2	140–180	absent	490–570	170–210
hyperophila	*sylvestris*	0	—	—	not evident	—	—
formosana	*thunbergii*	1	4·0–5·5	680–750	10–15 (–60)	720–760	300–320
schimitscheki	*nigra*	12	3·3–5·1	440–720	20–25	630–860	270–350
piniphila	*sylvestris*	2	3·9–4·5	490–530	10–75	460–590	180–250
neubergi	*mugho*	3	4·2–4·3	570–670	100–150	540–650	250–300
pinea	*sylvestris*	76	3·1–5·1	270–700	75–180	500–740	220–360
pergandei	*Pinus* spp.	7	2·9–4·5	310–570	100–310	490–620	190–230
piniformosana	*thunbergii*	35	2·4–4·1	300–550	50–75	440–660	170–260
atrotibialis	*insularis*	3	2·8–4·3	350–490	45–65	510–700	230–320
maritimae	*pinaster*	37	2·5–4·2	330–600	10–45 (–60)	390–620	160–270
watsoni	*rigida*	4	2·7–4·3	380–480	60–70	440–630	210–330

	length of longest hair on third antennal segment	hind tibia	abdominal tergites 3	8	Number of secondary rhinaria on antennal segments III	IV	V
lachnirostris	40–45	55–65	30–40	70–75	0 (–3)	0 (–3)	0 (–1)
hyperophila	50	—	80	—	—	—	—
formosana	55–65	75–85	30–40	130–140	0	0–1	1–2
schimitscheki	70–120	100–150	35–100	95–130	0	0	(0–)1(–2)
piniphila	60–80	90–120	70–80	70–90	0	0	0
neubergi	110–130	170–200	140–170	150–180	0	0	1–3
pinea	90–210	120–230	95–210	120–230	0 (–4)	0 (–2)	0 (–2)
pergandei	110–170	150–190	120–200	120–200	0	0–3	0–2
piniformosana	90–140	90–160	80–160	110–210	0 (–2)	0	0
atrotibialis	90–140	170–200	110–130	100–170	0	0	0
maritimae	60–120	70–130	120–180	120–180	(0)1–2(–6)	(0–)1–2(–4)	0–2
watsoni	110–150	150–175	130–150	120–180	0	0 (–1)	1

P. densiflora, luchuensis, massoniana, thunbergii group
Cinara formosana, C. piniformosana and possibly *C. maritimae*

P. halepensis (= maritima Lamarck), pinaster (= maritima Poiret) group
Cinara maritimae

P. insularis (including kesiya = khasya)
Cinara atrotibialis

P. leucodermis & nigra (= austriaca) including caramatica (= pallasiana)
Cinara schimitsheki

P. luchuensis, massoniana see densiflora
P. mugo (= montana Miller nec Lamarck)
Cinara neubergi

P. nigra see leucodermis
P. maritima see halepensis & pinaster

I

aperae viviparae of *Cinarella*

Length in μm of antennal segments V	Length in μm of antennal segments VI	Length of rostral segments in μm 4	Length of rostral segments in μm 5	Length of hind tarsal segments in μm 1	Length of hind tarsal segments in μm 2	Hind tibiae length in mm	Hind tibiae colour
230–260	200–210 + 75–100	170–180	55–65	180–190	360–370	1·9–2·0	paler on basal third
—	— —	190–210	105	120–150	310–370	—	paler on basal third
280–300	170–180 + 55–65	270–280	130–140	220–230	380–390	3·7–4·2	paler on basal half,
300–380	130–200 + 50–70	290–360	130–170	170–220	320–380	2·2–3·0	black
280–330	180–210 + 45–65	220–230	100–110	190–210	350–360	2·0–2·7	paler on basal third
300–340	170–210 + 50–65	280–300	125–145	220–240	390–450	2·3–2·7	paler on basal third
280–400	140–230 + 40–75	210–290	110–170	220–330	350–530	1·8–3·4	pale or spotted
260–360	175–220 + 50–65	150–230	70–110	180–230	300–370	2·0–2·8	dark, paler basally
230–320	130–210 + 50–75	150–210	85–105	160–215	320–430	1·7–2·5	black
280–410	150–240 + 60–80	310–360	125–140	180–210	290–360	1·7–2·0	dark
210–350	140–210 + 40–70	250–300	110–140	160–220	320–420	1·5–2·5	dark, paler basally
280–350	160–190 + 35–55	200–280	110–150	170–210	290–350	1·9–2·5	dark, paler basally

Number of hairs on first tarsal segment dorsally	antennal segments II	antennal segments VI Base	antennal segments VI processus terminalis subapically	accessory hairs on ultimate rostral segment	abdominal tergites 3	abdominal tergites 8	sub-genital plate
0	9	10	5–8	5–6	19	12	37
—	9	5–7	—	—	—	—	—
0	7–8	7–8	5	6	24	13	56
0	9–13	6–9	(3–) 4	6	26–73	27–60	50–62
1	10–13	7–11	4	4–6	29–63	22	44
0	7–8	5–7	4	4–5	18–28	15–18	36
1–2	5–9	2–8	(3–)4(–5)	4–6	18–49	13–26	22–52
0	6–10	4–8	4	4	50–110	15–28	40–55
0	7–14	6–10	4 (–5)	4–7	30–50	14–25	22–50
0	6–8	7–8	4	4–6	25–26	15–16	37
0–2	7–11	7–12	(3–)4–6	4–7	30–60	15–28	26–41
0	6–9	6–7	(3–) 4	4(–6)	50–60	13–19	45–55

P. pinaster see halepensis

P. resinosa

Cinara pinea

P. sylvestris including hamata (= sosnovskyi)

Cinara hyperophila, C. pinea, C. piniformosana, C. piniphila

P. thunbergii see densiflora

Subsection Australes

P. caribaea

Cinara maritimae

P. clausa

Cinara pergandei

P. echinata, glabra, taeda

Cinara pergandei, C. watsoni

TABLE 2

Discriminant proportions for the apterae viviparae of *Cinarella*

	Length of third antennal segment			Hind tibia length / longest hair borne on it	Antennal V / VI	Rostral 4 / 5	Rostral 4 / Hind tarsal 1	Length of second segment of hind tarsus	
	diameter of siphuncular cone	length of longest hair borne on it	length of fourth rostral segment					Rostral 4	hind tarsus 1
lachnirostris	3·0–3·7	12–14	2·9–3·2	32–33	0·75–0·9	2·9–3·0	0·9–1·0	2·0–2·2	1·9–2·1
hyperophila	1·5–2·7	—	—	—	—	1·8–2·1	1·4–1·6	1·5–1·8	2·1–2·6
formosana	0·9–1·1	12–13	2·6–2·8	47–48	1·2–1·3	1·9–2·0	1·2–1·3	1·3–1·5	1·6–1·8
schimitscheki	1·0–1·5	5·9–12	1·9–2·5	15–27	1·3–1·6	2·0–2·4	1·4–1·8	0·9–1·2	1·6–1·9
piniphila	0·8–1·2	6·0–10	2·0–2·7	18–28	1·1–1·3	1·9–2·0	1·0–1·2	1·6–1·7	1·8–1·9
neubergi	0·8–1·1	4·3–5·3	1·8–2·2	12–15	1·2–1·4	2·0–2·4	1·3–1·7	1·1–1·6	1·6–2·1
pinea	0·8–2·1	3·2–6·5	1·9–3·0	12–20	1·1–1·7	1·6–2·2	0·8–1·2	1·4–2·0	1·4–1·9
pergandei	0·9–1·4	3·5–4·3	2·3–3·1	11–15	1·1–1·4	1·8–2·3	0·7–1·2	1·4–2·2	1·5–1·7
piniformosana	0·9–1·7	3·4–5·5	2·6–3·3	15–23	1·0–1·5	1·5–2·2	0·8–1·2	1·7–2·4	1·7–2·3
atrotibialis	1·1–1·5	4·0–7·0	1·5–1·9	9–11	1·2–1·5	2·4–2·6	1·5–1·8	0·9–1·1	1·5–1·8
maritimae	0·8–1·4	4·0–7·5	1·5–2·0	16–26	1·0–1·4	2·0–2·4	1·3–1·7	1·1–1·6	1·7–2·1
watsoni	1·1–1·6	3·5–5·0	2·0–2·4	12–15	1·1–1·6	1·7–2·3	1·2–1·5	1·1–1·4	1·6–1·8

P. elliotti
Cinara maritimae, C. watsoni

P. pungens, rigida, serotina
Cinara watsoni

P. taeda see echinata & glabra

Subsection Contortae (= Insignes of Shaw in part)
P. banksiana
Cinara pergandei, C. watsoni
P. virginiana (= inops)
Cinara pergandei, C. pinea

Subsection Oocarpae (= Insignes of Shaw in part)
P. radiata (= insignis)
Cinara maritimae

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AMERICAN LEAF-LITTER THYSANOPTERA OF THE GENERA *ERKOSOTHRIPS, EURYTHRIPS* AND *TERTHROTHRIPS* (PHLAEOTHRIPIDAE : PHLAEOTHRIPINAE)

L. A. MOUND

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ENTOMOLOGY Vol. 35 No. 2
LONDON : 1976

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AMERICAN LEAF-LITTER THYSANOPTERA OF THE GENERA *ERKOSOTHRIPS, EURYTHRIPS* AND *TERTHROTHRIPS* (PHLAEOTHRIPIDAE : PHLAEOTHRIPINAE)

BY

LAURENCE ALFRED MOUND

Pp. 25–64; 50 *Text-figures*

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THE BRITISH MUSEUM (NATURAL HISTORY)
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AMERICAN LEAF-LITTER THYSANOPTERA OF THE GENERA *ERKOSOTHRIPS, EURYTHRIPS* AND *TERTHROTHRIPS* (PHLAEOTHRIPIDAE : PHLAEOTHRIPINAE)

By L. A. MOUND

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SYNOPSIS

Keys are provided to the eight species of *Erkosothrips* (in which two new specific synonyms and two new combinations are established) and 38 species of *Eurythrips* (in which 15 new specific synonyms and six new combinations are established). A check list is given and includes 27 species of *Terthrothrips*. These genera are restricted to North and South America. Reasons are presented for accepting the validity of the two African genera *Porcothrips* and *Zuluiella*.

INTRODUCTION

The Thysanoptera which live in leaf litter provide a series of complex taxonomic problems. Many species are widespread in this habitat, a few display clinal variation in structure (Mound, 1972*a*), others display allometric patterns of growth which are sometimes sex linked (Mound, 1974*b*), yet others display confusing patterns of variation which do not at present have any explanation (Mound, 1972*b*). It is not only at the species level that this variation is difficult to interpret, the genera of leaf-litter thrips are frequently ill-defined assemblages of more or less similar forms. Unfortunately most of the nominal species have been based on only one sample, or one morph or even one specimen. Despite the fact that there are 54 specific names available in the genus *Eurythrips* few of these species have ever

been illustrated or compared one to another, and there is little discussion in the literature of intraspecific variation. Before the genera can be better defined it is essential to re-examine the variation within and between the known species, and this is the limited objective of the present paper.

The only published key to the species of *Eurythrips* is limited to those species which have been found in Illinois (Stannard, 1968). Most of the species in this genus were described by J. D. Hood whose collection was not generally available to other workers until after it was purchased by the Smithsonian Institute in 1964. The specific criteria used by Hood can now be shown to be periodically inconsistent, and some of his descriptions are inaccurate. Moreover the type-series of several species described by J. R. Watson included mixtures of more than one species. These problems led to misidentifications by other workers with the result that 16 of the 54 specific names in *Eurythrips* are placed in synonymy in the present study. Unfortunately the number of samples available is still inadequate in most species and further synonymy probably awaits discovery. Leaf-litter thrips appear to be restricted to the eastern half of the United States, few specimens having been seen from west of longitude 95°. This probably represents a true faunal difference associated with differing soil conditions. However, even within the eastern U.S.A. most Thysanoptera have been collected close to the well-established areas of entomological work, Illinois, Washington D.C., Cornell and Gainesville. In the Neotropics most specimens have been collected in Brasil (Santa Catarina State), Panama and Trinidad. No specimens have been studied from western South America although there are a number of undescribed species from Columbia in the Senckenberg Museum, Frankfurt.

ECOLOGY AND EVOLUTION IN LEAF-LITTER THYSANOPTERA

The complexities of structural variation in leaf-litter thrips are probably determined by the habitat. Allometric growth patterns, as well as the production of winged or wingless morphs, are probably controlled by the amount of food ingested by developing larvae. However, the quantity and quality of food available will vary with the season and weather conditions because these thrips feed on fungal hyphae or the breakdown products of hyphal decay. The capacity to react to these fluctuations in the environment, both by varying the body structure and by varying the size of populations, is an important biological characteristic which is itself inherited by many species. Moreover, because of the relative uniformity of the leaf-litter habitat populations are extensive as well as locally dense, and the infrequency of winged individuals will result in a low rate of gene flow through these extensive populations (Mound & O'Neill, 1974). Localized variations within these populations will therefore not be eradicated quickly resulting in the observable pattern of variation within and between localities. Taxonomists have traditionally treated this type of variation in a simplistic manner, by naming as a new species each sample which differs structurally from other samples, be this one or many individuals. This approach does not have a valid philosophical basis

within the known and presumed biology of these insects as outlined above. The leaf-litter Thysanoptera appear to include a number of good examples of reticulate evolution, in which one or more characters have been suppressed genetically in any one line, that is not expressed phenotypically although still available within the genetic framework, but have reappeared in that line at a later stage. Dollos law appears to be quite inapplicable to this group of insects.

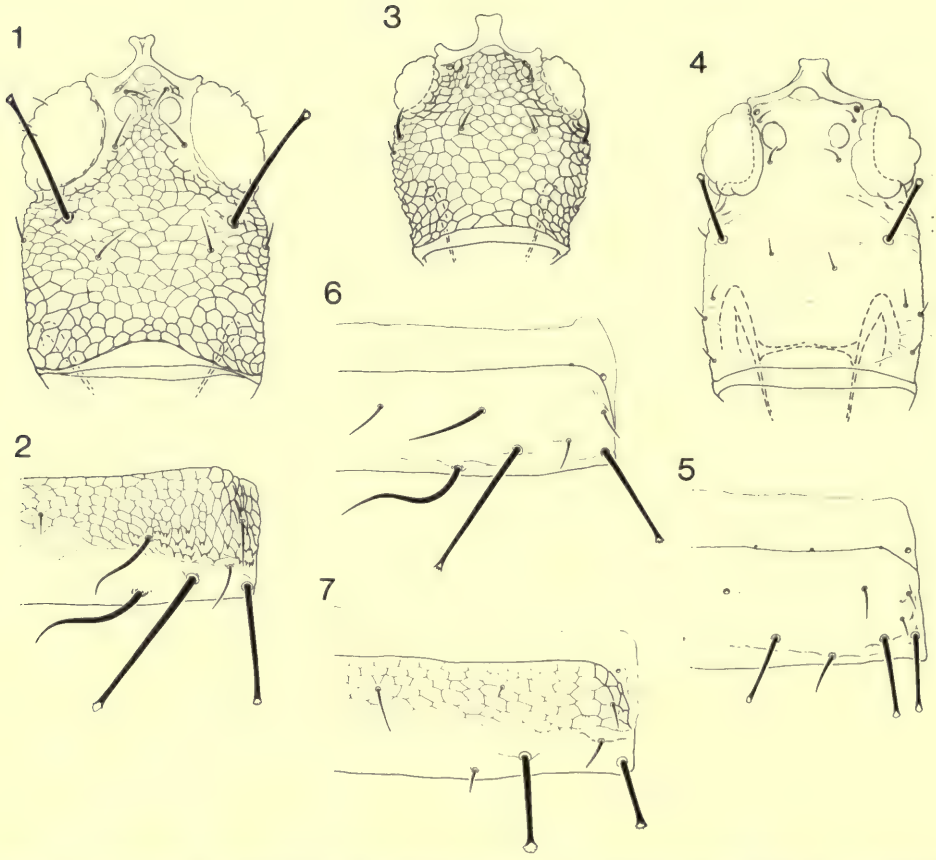
GENERIC RELATIONSHIPS

The genera related to *Eurythrips* are very difficult to assess. Hood (1954 : 25) refers to the problem of defining genera in this group and states that there are 'so many puzzling cross-resemblances that one wonders whether we have not in effect cut across the grain, rather than with it'. In fact Hood appears to have placed species in different genera in an arbitrary fashion and there are probably further specific synonymies to be found in which the species were described originally in different genera. Any future analysis of this group must be based on Hood's collection, including not only the types and long series of identified specimens but also the many hundred mounted specimens which Hood left unlabelled and unworked. The genera to be studied include *Copiothrips*, *Phragmothrips*, *Pleurothrips* and *Orthothrips* none of which can be distinguished satisfactorily from the three genera discussed in this paper.

GENERA EXCLUDED FROM THE *EURYTHRIPS* COMPLEX

The ten Neotropical species described in *Porcothrips* are here all transferred to *Erkosothrips*, *Eurythrips* or *Terthrothrips*. The genus *Porcothrips* Priesner (1951) is here regarded as a valid genus for one West African species, *P. liberiensis* (Priesner), which is known from a single specimen. Further material is needed of this species to determine the condition of the prothoracic sternites. The head is almost completely reticulate (Text-fig. 1) but the setae on the basal antennal segments are all acute. The epimeral sutures are probably complete and both pairs of setae on the anterior margin of the pronotum are very small. The mesonotal mid-lateral setae are 50 μm long but the pterothoracic ventrolateral setae are short and acute. The metanotum and pelta are reticulate, and the lateral areas of the abdominal tergites sculptured (Text-fig. 2). The sternal accessory setae are long and stout, there are at least eight setae on sternite eight on which segment the median marginal setae are exceptionally stout. The fore tibia has a fringe of long setae on the inner margin.

The genus *Zuluiella* Jacot-Guillarmod (1939) was synonymized with *Eurythrips* by Stannard (1968). However, the type-species *Z. distincta* Jacot-Guillarmod from South Africa can be distinguished from all *Eurythrips* species by the presence of a maxillary bridge (Text-fig. 4), the well developed pronotal anteromarginal setae, and also by the large median setae on the tergites (Text-fig. 5). For these reasons *Zuluiella* must at present be accepted as a valid genus. The only other



FIGS 1–7. Heads and right hand side of tergite IV. 1, 2, *Porcothrips liberiensis*; 3, *Erkosothrips subcalvus*; 4, 5, *Zuluiella distincta*; 6, *Eurythrips ampliventralis* (*cornutus* holotype); 7, *Eurythrips virginianus*.

species placed in this genus is *Zuluiella antennata* Jacot-Guillarmod (1940). This species was placed in *Malacothrips* by Hartwig (1952), and this seems to be a reasonable generic placement in view of the well developed pronotal anteromarginal setae and the very weakly developed praepectal plates.

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This study was made possible firstly by the bequest to the British Museum (Natural History) (later abbreviated to BMNH in the text) of the collections of Floyd Andre including long series of North American *Eurythrips* (Mound, 1974*a*), and secondly by the courtesy of Kellie O'Neill and her husband Dr B. D. Burks in providing the author with the opportunity to work in Washington on the Hood collection for four weeks during 1975. The author is grateful to the following for

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CHECK LIST OF THE SPECIES DISCUSSED IN THIS PAPER

ERKOSOTHRIPS Stannard, 1955
- ***bucca*** Hood, 1957
- ***caelatoris*** (Hood, 1954) **comb. n.**
- ***claviger*** (Hood, 1941)
- ***floridensis*** Stannard, 1955
- ***interior*** Stannard, 1955
- ***reticulatus*** (Watson, 1934)
  - *sculpturatus* (Hood, 1936) **syn. n.**
  - *silvarum* (Hood, 1941) **syn. n.**
- ***silvaticus*** Hood, 1957
- ***subcalvus*** (Hood, 1954) **comb. n.**

EURYTHRIPS Hinds, 1902
- ***alarius*** Hood, 1957
- ***ampliventralis*** Hinds, 1902
  - *amplus* Hood, 1934 **syn. n.**
  - *conjunctus* Hood, 1934 **syn. n.**
  - *connatus* Hood, 1938 **syn. n.**
  - *cornutus* Moulton, 1929 **syn. n.**
  - *disjunctus* Hood, 1941 **syn. n.**
- ***batesi*** (Watson, 1935)
- ***bifasciatus*** (Hood, 1954) **comb. n.**
- ***bisetosus*** (Hood, 1954) **comb. n.**
- ***citricollis*** Hood, 1941
- ***citricornis*** (Hood, 1954) **comb. n.**
  - *occipitalis* Hood, 1957 **syn. n.**
- ***conformis*** Hood, 1957
- ***costalimai*** Hood, 1950
- ***cruralis*** Hood, 1957
- ***dissimilis*** Hood, 1938
- ***elongatus*** Hood, 1957
- ***forticauda*** (Hood, 1954) **comb. n.**
- ***forticornis*** Hood, 1939
- ***fuscipennis*** Moulton, 1929
- ***genarum*** Hood, 1957
  - *constrictus* Stannard, 1958 **syn. n.**
- ***hemimeres*** Hood, 1957
- ***hindsi*** Morgan, 1913
  - *eddeyi* (Watson, 1935) **syn. n.**
- ***hookae*** Hood, 1933
- ***longilabris*** Watson, 1921
  - *harti* Hood, 1925 **syn. n.**

modestus (Bagnall, 1917)
cinctus Hood, 1927 **syn. n.**
varius Moulton, 1929 **syn. n.**
xanthozonus Hood, 1957 **syn. n.**
musivi Hood, 1957
nigriceps Hood, 1957
nigricornis Hood, 1960
osborni Hinds, 1902
macrops Hood, 1925 **syn. n.**
setiger Stannard, 1958 **syn. n.**
peccans Hood, 1957
pettiti Hood, 1941
pusillus Hood, 1957
setosus Hood, 1950
simplex (Hood, 1954) **comb. n.**
striolatus Hood, 1957
subflavus Hood, 1950
tarsalis Hood, 1925
montanus (Watson, 1933)
morulops Hood, 1950 **syn. n.**
trifasciatus (Hood, 1954) **comb. n.**
tristis Hood, 1941
umbrisetis Hood, 1933
virginianus Hood, 1952
watsoni Hood, 1941
TERTHROTHRIPS Karny, 1925
balteatus Hood, 1957 : 152
bicinctus Hood, 1954 : 34
brunneus Hood, 1957 : 148–149
bucculentus Hood, 1957 : 145–146
bullifer Hood, 1957 : 149–150
carens Hood, 1957 : 147–148
clavivestis Hood, 1935 : 195–199
cochlearius Hood, 1954 : 27–28
consobrinus Hood, 1954 : 25–26
crassus Hood, 1954 : 28–29
fuscatus Hood, 1954 : 29–30
gracilicornis (Hood, 1925 : 59)
gracilis Hood, 1954 : 29
hebes Hood, 1957 : 152–153
impolitus Hood, 1957 : 153–154
irretitus Hood, 1957 : 150–151
longulus Hood, 1954 : 26–27
luteolus Hood, 1957 : 151–152
magnicauda Stannard, 1955 : 174
minor Hood, 1954 : 28
peltatus Hood, 1957 : 146–147
percultus Hood, 1957 : 154–155
sanguinolentus (Bergroth, 1896 : 66)
serratus Hood, 1954 : 31–32
striaticeps Hood, 1954 : 26
unicinctus Hood, 1954 : 30–31
viduus Hood, 1957 : 147

ERKOSOTHRIPS Stannard

Erkosothrips Stannard, 1955 : 81–83. Type-species: *E. interior* Stannard, by original designation.

This genus was erected for a group of species in which the head is conspicuously reticulate and some of the setae on the basal antennal segments have dilated apices (Text-figs 3, 34). Unfortunately, neither on these characters nor on any others can *Erkosothrips* be satisfactorily distinguished from either *Eurythrips* or *Copiothrips*. The Neotropical species described in *Porcothrips* are transferred in this paper to *Eurythrips*, *Erkosothrips* or *Terthrothrips*, but the species in *Copiothrips* have yet to be re-examined. *Eurythrips virginianus* has the dorsal surface of the head partially sculptured and the setae on antennal segments II and III are broad at the apex (Text-figs 26, 32). Typical *Erkosothrips* have the postocular setae rather short (Text-fig. 3), but in *caelatoris* these setae are much longer than in the type-species. Moreover the head of *caelatoris* is weakly sculptured and rather similar to *Eurythrips trifasciatus* (Text-fig. 23). In *Erkosothrips bucca* the postocular setae are nearly straight, not curved, although the head is densely reticulate; however, the antennal setae do not have expanded apices. *Erkosothrips*, as defined by Stannard (1957) is probably polyphyletic, the sculptured dorsal surface to the head having evolved independently in both the North American *Eurythrips* line as well as the South American *Terthrothrips* line. Macropterae are known for only two species in the genus, *caelatoris* and *reticulatus*.

Key to species

(* species not studied)

1 Ventrolateral setae on metathorax acute at apex 2
– Ventrolateral setae on metathorax expanded at apex 3
2 Antennal segments II–III with one or more pairs of expanded setae; segments IV–V with slender pedicel about twice as long as wide; ♂ with narrow glandular area near anterior margin of sternite VIII [Florida to New York and Iowa] ***reticulatus*** (p. 35)
– Antennal segments II–III with all setae acute at apex; segments IV–V with pedicels scarcely as long as wide; ♂ glandular area on sternite VIII circular with long accessory setae arising laterally [Brazil] . . . . . ***bucca*** (p. 34)
3 Median dorsal setae of head usually expanded at apex 4
– Median dorsal setae of head acute at apex (Text-fig. 3). 6
4 Abdomen largely yellow; lateral setae near pelta expanded apically [Michigan, Illinois, Missouri] . . . . . ***interior*** (p. 35)
– Abdomen brown; lateral setae near pelta acute at apex 5
5 Postocular setae placed in line with lateral margin of eye; ♂ with narrow glandular area at anterior margin of sternite VIII; ♀ not known [Florida] . ****floridensis*** (p. 35)
– Postocular setae placed mesad of lateral margin of eye; ♂ with glandular area occupying most of sternite VIII; ♀ with setae B_1 and B_2 on tergite IX expanded at apex [New York; Michigan] . . . . . ***claviger*** (p. 34)
6 Major setae exceptionally short, pronotal posteroangular setae less than one-fifth as long as median length of pronotum; antennal segment IV with 2 sense cones (Text-fig. 34); setae B_1 and B_2 on tergite IX expanded at apex [Brazil]. ***subcalvus*** (p. 36)

– Major setae normal, pronotal posteroangular setae more than one-third as long as median length of pronotum; antennal segment IV with 4 sense cones; setae B_1 on tergite IX expanded at apex, but B_2 acute 7

7 Body largely yellowish brown, tube dark brown; median area of tergites polygonally reticulate [Brazil] . . . . . ***silvaticus*** (p. 36)

– Body brown, legs yellowish brown; median area of tergites with transversely elongate reticulations [Brazil] . . . . . ***caelatoris*** (p. 34)

Erkosothrips bucca Hood

Erkosothrips bucca Hood, 1957 : 167. Holotype ♀, Brazil (USNM) [examined].

This micropterous species is known only from the type-series of six females and three males.

Specimens studied.

Brazil: Santa Caterina State, Nova Teutonia, holotype ♀ with 3 ♀, 2 ♂ paratypes under fallen leaves, iv. 1954 (*F. Plaumann*) (USNM).

Erkosothrips caelatoris (Hood) comb. n.

Porcothrips (?) *caelatoris* Hood, 1954 : 34. Holotype ♀, Brazil (USNM) [examined].

This species is intermediate between *Erkosothrips*, *Copiothrips* and *Eurythrips*. Although described from a single micropterous female there is a series of specimens in the Hood collection including macropterous females as well as micropterae of both sexes.

Specimens studied.

Brazil: Santa Catarina State, Nova Teutonia, holotype ♀ microptera, viii. 1952 (*F. Plaumann*), also 40 specimens (♂ ♀ and ♀ mac.) from same locality on various dates 1953–4 (USNM).

Erkosothrips claviger (Hood)

Eurythrips claviger Hood, 1941 : 166–169. Holotype ♀, U.S.A.: New York (USNM) [examined].
Erkosothrips claviger (Hood) Stannard, 1955 : 83–84.

This micropterous species was described from six females and 15 males collected in New York, but Stannard records a further nine specimens from Michigan and suggests the species is northern in its distribution.

Specimens studied.

U.S.A.: New York, Oswegatchie, holotype ♀ on dead grass and debris, 26.viii.1940 (*J. D. Hood*), together with 3 ♀, 12 ♂ paratypes bearing similar data (USNM).

Erkosothrips floridensis Stannard

Erkosothrips floridensis Stannard, 1955 : 84. Holotype ♂, U.S.A.: Florida (INHS) [not examined].

This species was described from two males collected in leaf mould in the Everglades National Park, Florida. These specimens have not been studied and the species is placed in the key above from the original description and illustration. The female is unknown, and the possibility that the two original males are aberrant specimens of *reticulatus* needs further investigation.

Erkosothrips interior Stannard

Erkosothrips interior Stannard, 1955 : 84–85. Holotype ♀, U.S.A.: Illinois (INHS) [not examined].

This species was described from 17 ♀, 10 ♂ collected in Illinois and one female collected in Michigan. Subsequently Stannard (1968 : 409) recorded the species from Missouri. Although the abdomen is yellow, *interior* is similar in structure to both *claviger* and *floridensis*.

SPECIMENS STUDIED.

U.S.A.: Illinois, Allerton, 1 ♀, 1 ♂ paratypes in woodland litter, 5.iv.1940; I., Monticello, 1 ♀ in woodland cover, 28.ix.1938 (*Farrer*) (USNM).

Erkosothrips reticulatus (Watson)

Glyptothrips reticulatus Watson, 1934 : 45–46. LECTOTYPE ♀, U.S.A.: Florida (FSAC), here designated [examined].
Eurythrips sculpturatus Hood, 1936 : 5–9. Holotype ♀, U.S.A.: Louisiana (USNM) [examined]. **Syn. n.**
Eurythrips silvarum Hood, 1941 : 163–166. Holotype ♀, U.S.A.: New York (USNM) [examined]. **Syn. n.**
Erkosothrips reticulatus (Watson) Stannard, 1955 : 85; 1968 : 409–410.

Stannard (1955) distinguished *sculpturatus* from *silvarum* on the degree of swelling of the cheeks and the position of the postocular setae, although subsequently he stated (1968 : 410) that these characters could not be used to distinguish between these species satisfactorily. Usually the *silvarum* head shape is found in apterae and the *sculpturatus* head shape in micropterae, and both of these forms are represented in the syntype series of *reticulatus* in the Hood collection. Stannard did not place *reticulatus* in his key to species (1955) because the 'holotype' referred to by Hood (1941 : 163) was not available for study and Watson's original series evidently contained more than one species. However, later, Stannard (1968 : 410) designated a lectotype for *reticulatus*, although as neither the locality (Gainesville) nor the collector (Bates) of this specimen are mentioned in the original description this designation is invalid. The 'holotype' referred to by Hood apparently remained in Hood's collection until 1975 when it was studied by the present author in Washington. This specimen, which is here designated lectotype, has the head

shaped like *sculpturatus* with the postocular setae arising mesad of the external eye margin. However the cheek setae are not expanded apically, the B_1 setae on the ninth abdominal tergite are abruptly rounded, not broadly expanded apically, and the specimen is apterous, not micropterous. The lack of correlation between these various characters, both in this specimen and in several of the others listed below, has led the present author to regard all the material as conspecific. The different forms have been collected together both in Florida and Virginia. Stannard (1968) refers to a macropterous female from North Carolina.

MATERIAL STUDIED.

U.S.A.: Florida [Levy County], Gulf Hammock, lectotype ♀ of *reticulatus*, 'Type ♀' on slide with 1 ♂ from dead leaves of sweet gum, oak etc. on ground (*A. N. Tissot*) (FSAC); F., Petersburg, 'type ♂' of *reticulatus*, dead leaves, mostly oak, 3.ix.1933 (*J. W. Hea*) (FSAC); F., Gainesville, 1 ♀ paralectotype of *reticulatus*, 17.i.1932; F., Hawthorne, 1 ♀ paralectotype of *reticulatus*, 1.ii.1932 (USNM); F., Mariana, 1 ♀, 1 ♂ in moss, 3.iii.1933 (BMNH); Louisiana, Tallulah, holotype ♀ of *sculpturatus* with 2 ♀, 2 ♂ paratypes in humus, 11.v.1934 (*J. W. Folsom*) (USNM); Georgia, Abbeville, 3 ♂, iii. 1950 (USNM); Virginia, Falls Church, 6 ♀, 2 ♂ in moss, 1943–45 (*F. Andre*); V., Mt Vernon, 4 ♀, 1 ♂ in sedge, 1940–44 (*F. Andre*) (BMNH); V., Lexington, 1 ♀, 2 ♂, xi. 1940 (USNM); Maryland, Libertytown, 1 ♀, 1 ♂ in moss, 1944 (*F. Andre*) (BMNH); Iowa, White, 1 ♀, 2 ♂ in moss, 12.xii.1935 (*F. Andre*); I., Page County, 1 ♀ in dead leaves, xii. 1935 (*F. Andre*) (BMNH); New York, Enfield Glen State Park, holotype ♀ of *silvarum* on fallen pine needles, 15.ix.1940 (*F. R. Nevin*) (USNM, with 30 ♀, 17 ♂ from type-locality, 1 ♀ paratype BMNH).

Erkosothrips silvaticus Hood

Erkosothrips silvaticus Hood, 1957 : 166–167. Holotype ♀, BRAZIL (USNM) [examined].

This micropterous species is known only from the type-series of 23 females and six males. This species resembles several species placed at present in *Copiothrips*.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ under fallen leaves, vi. 1954 (*F. Plaumann*) (USNM); 20 ♀, 4 ♂ paratypes with similar data except for collection dates (USNM).

Erkosothrips subcalvus (Hood) **comb. n.**

(Text-figs 3, 34)

Porcothrips subcalvus Hood, 1954 : 33–34. Holotype ♀, BRAZIL (USNM) [examined].

Although this micropterous species was described in *Porcothrips* it is similar to several species in *Copiothrips* and *Erkosothrips*, particularly to *E. reticulatus*. The ventrolateral setae on the metathorax have expanded apices although they are scarcely 25 μm long. The original series comprised seven females.

SPECIMENS STUDIED.

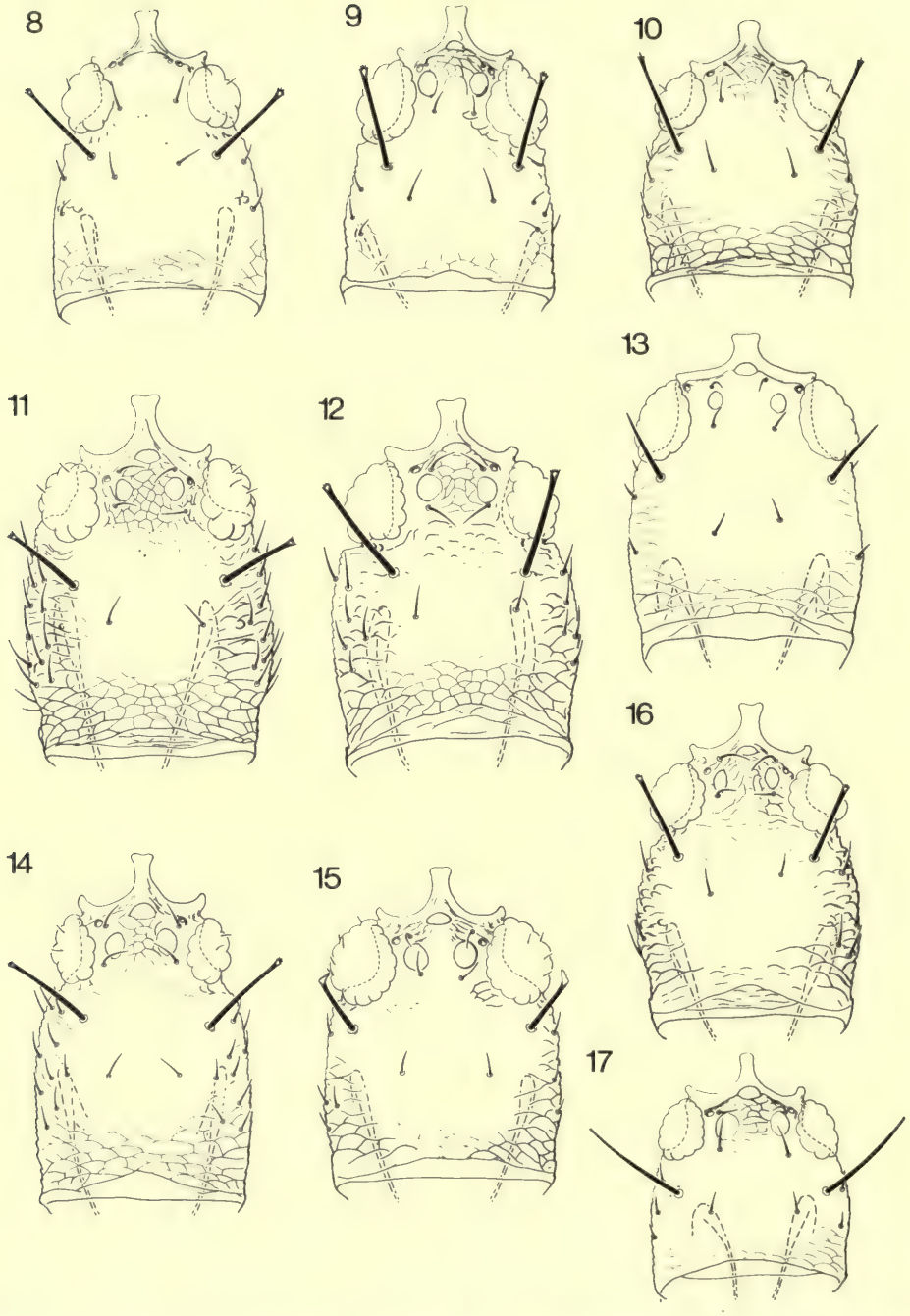
BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ with 5 ♀ paratypes, viii. 1952 (*F. Plaumann*) (USNM); also about 70 specimens of both sexes with similar data to holotype, collected 1953–55 (USNM; 1 ♀ in BMNH).

EURYTHRIPS Hinds

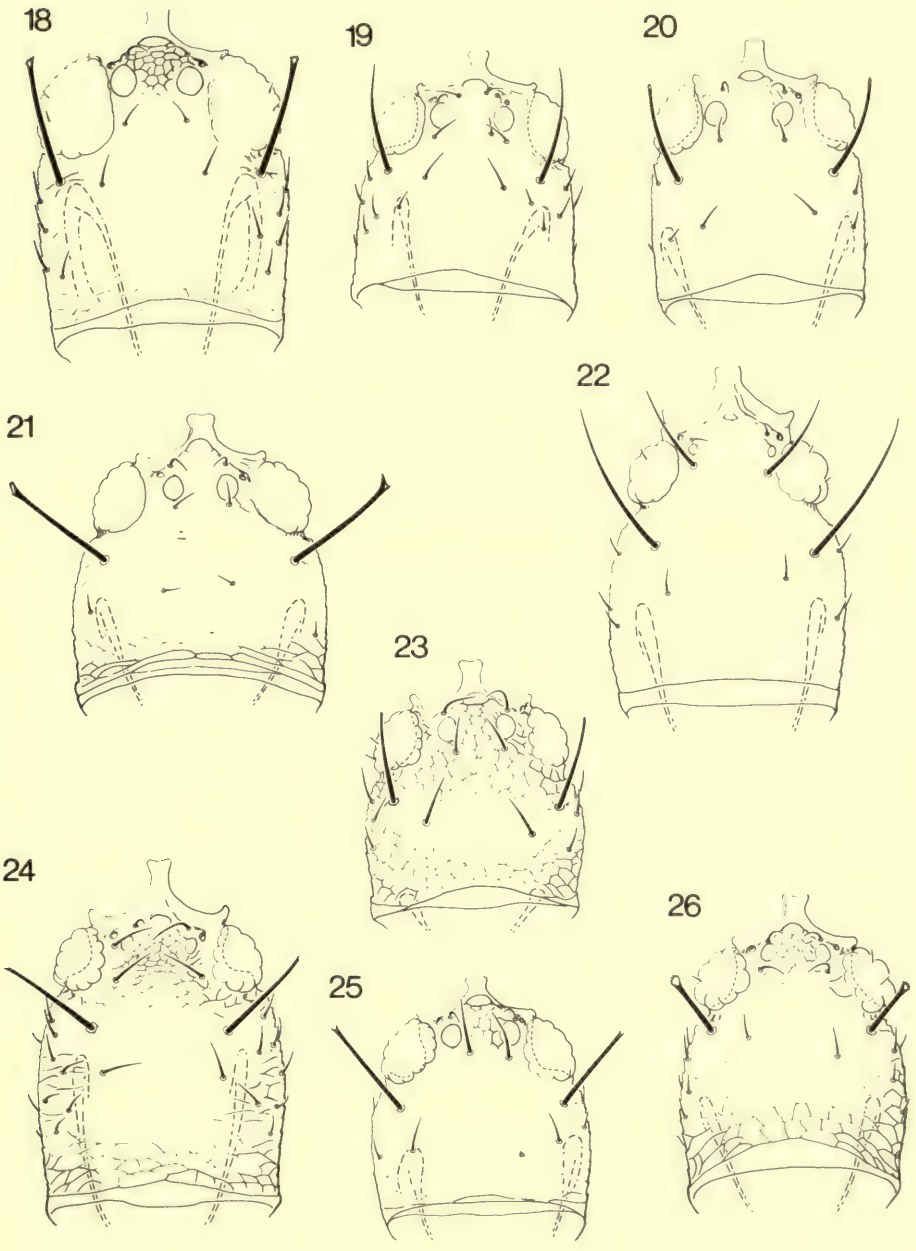
Eurythrips Hinds, 1902 : 202. Type-species: *E. ampliventralis* Hinds, by original designation.

The genus *Eurythrips* has been defined by Stannard (1957) although at present it cannot be satisfactorily distinguished from *Erkosothrips*, *Terthrothrips*, *Copiothrips*, *Orthothrips*, *Phragmothrips* and *Pleurothrips*. Moreover most of the Neotropical species described in *Porcothrips* are here placed in *Eurythrips*. None of the species in *Eurythrips* has reticulation on the head close to the postocular setae, although in a few species the median area of the head between these setae is weakly reticulate (Text-fig. 23). In contrast, the species in *Erkosothrips* have the dorsal surface of the head entirely reticulate, and moreover, the postocular setae are usually short (Text-fig. 3) and some of the setae on the basal antennal segments have blunt or expanded apices. All the species in this complex of genera from the New World have large praepectal plates on the ventral surface of the prothorax, and the pronotal anteromarginal setae are always short although the anteroangulars are usually long (Text-figs 27, 28). Certain species of *Malacothrips* are very similar to *Eurythrips* species, notably *Malacothrips roycei* Hood from Florida and *M. antennatus* (Jacot-Guillarmod) from South Africa. However, both of these species have well developed pronotal anteromarginal setae and the praepectal plates are either absent or weakly developed.

The species of *Eurythrips* exhibit a variety of patterns of structural variation and also of geographical distribution. As interpreted here, *ampliventralis* is a widespread species extending from Iowa in the north, through Panama and Trinidad to southern Brazil. No structural variation has been observed to be correlated with geographical distribution in *ampliventralis* although four nominal species from the Neotropics, each with a foretarsal tooth, may be geographical variants of this species. However, at several sites throughout its range *ampliventralis* has been found to vary in the width of the pedicel of the terminal antennal segments (Text-figs 35, 36), and moreover the number of antennal sense cones is not constant. Another species with an extensive range is *batesi*. This is found from Maryland to Mexico and Trinidad, but is relatively constant in structure. In contrast *modestus* is a widespread and variable species from the Carribean area to Brazil, and it is possible that *nigricornis* is the same species. Moreover *longilabris* from Texas and Florida is also closely related, although this species is itself probably only an extreme southern variant of the North American species *hindsi*. This type of 'Rassenkreise' is also known in the leaf-litter genus *Allothrips* in North America (Mound, 1972*a*). Unfortunately half of the species of *Eurythrips* are still known from single samples or even single specimens. Many of these will probably be placed in synonymy when their variation is worked out.



FIGS 8–17. Heads of *Eurythrips* species. 8–10, *ampliventralis* (8, *disjunctus* paratype; 9, *cornutus* paratype); 11, *bisetosus*; 12, *citricornis*; 13, *dissimilis*; 14, *elongatus*; 15, *forticauda*; 16, *hemimeres*; 17, *hindsi*.



FIGS 18–26. Heads of *Eurythrips* species. 18, *hookae*; 19, *longilabris*; 20, *modestus* (*cinctus* holotype); 21, *osborni*; 22, *tarsalis*; 23, *trifasciatus*; 24, *simplex*; 25, *tristis*; 26, *virginianus*.

Most of the characters used in the key to species below are relatively simple. However, the variation in a character is in most species directly related to the number of samples studied, and so the key will be least effective in areas from which samples are at present not available, e.g. South Carolina, Georgia and Arkansas. The form of the setal apices which is used in the key refers to specimens mounted in Balsam (Mound & Pitkin, 1972). Specimens mounted in chloral hydrate and gum arabic mountants frequently have the setal apices deformed. These mountants can cause a weakly expanded setal apex to collapse and appear perfectly normal but acute. The author has used the botanical term 'acuminate' to indicate an acute seta with the apex drawn out evenly to a long fine point. The term 'pointed' which has frequently been used previously covers a variety of setal structure. The author distinguishes as 'softly pointed' or 'blunt' those setal apices which, when examined in Canada Balsam with phase contrast microscopy, can be seen to be translucent and minutely flattened at the apex. The most common species with setae of this type is *ampliventralis* in which the B_1 setae on the ninth tergite are 'pointed' (teste Stannard, 1968 : 414) but are certainly not 'acuminate' in the sense of couplet 8 of the key below.

Key to species

1 Head reticulate between the postocular setae (Text-fig. 23); pelta with distinct lateral wings 2

– Head not reticulate between the postocular setae, rarely with transverse lines of sculpture (Text-figs 8–17); pelta usually different 5

2 Pronotal anteroangular setae about 15 μm long, less than 0·25 as long as posteroangular setae; antennal segment IV with four sense cones (Text-fig. 29).
Dorsal surface of head with equiangular polygons (Text-fig. 23); ♂ glandular area occupies most of sternite VIII [Brazil] . . . . . ***trifasciatus*** (p. 60)

– Pronotal anteroangular setae almost as long as posteroangular setae, antennal segment IV with three sense cones 3

3 Setae B_1 on tergite IX scarcely wider at apex than B_2, softly pointed; head with transversely elongate polygons medially [Brazil] . . . . . ***striolatus*** (p. 59)

– Setae B_1 on tergite IX sharply expanded at apex, B_2 acute at apex; head with equiangular reticulations 4

4 Head dark brown, darker than pronotum [Brazil] . . . . . ***musivi*** (p. 56)

– Head yellowish brown, lighter than pronotum [Brazil] . . . ***bifasciatus*** (p. 48)

5 Head exceptionally long, more than 1·8 times as long as width across eyes (Text-fig. 14).
Head, metathorax, abdominal segments VIII–X, antennal segments I–II and VI–VIII brown, rest of body and legs yellow; ♂ without glandular area on sternite VIII [Brazil] . . . . . ***elongatus*** (p. 51)

– Head variable in shape, always less than 1·7 times as long as width across eyes . 6

6 Antennal segments II–III bearing one or more setae with expanded apices (Text-figs 32, 33).
♂ sternite VIII with narrow glandular area at anterior margin, sometimes with one or more accessory setae between glandular area and posteromarginal setae (Text-fig. 44); setae B_1 and B_2 on tergite IX expanded at apex . . . 7

– Antennal segments II–III with all setae acute 8

7 Pterothoracic ventrolateral setae with expanded apices; dorsal setae on antennal

segment II strongly expanded, segment IV with four sense cones (Text-fig. 33); pronotal epimeral sutures usually complete; pelta and median area of tergites very weakly sculptured [Brazil] . . . . . ***forticauda*** (p. 51)

– Pterothoracic ventrolateral setae small with acute apices; dorsal seta on antennal segment II blunt, segment IV with three sense cones (Text-fig. 32); pronotal epimeral sutures not complete; pelta and median area of tergites sculptured [eastern U.S.A.] . . . . . ***virginianus*** (p. 61)

8 Setae B_1 on tergite IX acuminate at apex; dorsolateral setae on tergite VII frequently acuminate 9

– Setae B_1 on tergite IX never acuminate, softly pointed with apex translucent to blunt or expanded; dorsal posterolateral setae on tergite VII blunt or expanded at apex 21

9 Body, antennae and legs clear yellow, head, tube and antennal segments VII–VIII weakly shaded greyish brown [Brazil] . . . . . ***subflavus*** (p. 59)

– Body colour different, more extensively brown 10

10 Abdominal segment II yellow in contrast to segments VII–IX which are brown . 11

– Abdominal segments more or less uniformly brown, segments IV–VI sometimes paler than II–III and VII–IX 13

11 Pronotum and abdominal segments I–VI, also legs, yellow; head and tube brown, pterothorax light brown, antennae brown, segment II paler distally.
Pronotal epimeral sutures not complete; antennal segment III with three sense cones [Florida] . . . . . ***citricollis*** (p. 49)

– Pronotum and abdominal segments IV–IX brown 12

12 Antennal segment III with three sense cones; hind femora yellow [Brazil].
nigricornis (p. 56)

– Antennal segment III with two sense cones; hind femora brown [West Indies, Panama, Brazil] . . . . . ***modestus*** (p. 55)

13 Abdominal segments IV–VII yellow with brown shading medially; antennae brown except pedicel of III; tube yellow in distal half; antennal segments III and IV with three sense cones; setae B_1 on tergite IX acuminate and longer than tube, on tergite VII expanded at apex; postocular and pronotal setae expanded at apex, pretarsal tooth less than 0·25 times as long as tarsal width [Panama]
hookae (p. 54)

– Not this combination of characters 14

14 Fore tarsal tooth small, less than 0·25 times as long as tarsal width in both sexes; pronotal anteroangular setae usually 0·5 times as long as posteroangular setae . 15

– Fore tarsal tooth large in both sexes, usually more than 0·5 times as long as tarsal width; anteroangular setae frequently less than 0·25 times as long as posteroangular setae 18

15 Postocular setae clearly expanded at apex.
Head with median dorsal setae and postocellar setae usually small but sometimes elongate (Text-fig. 25); ♂ glandular area occupies most of sternite VIII [eastern U.S.A.] . . . . . ***tristis*** (p. 60)

– Post ocular setae acuminate or blunt 16

16 Antennal segment IV with four sense cones [Brazil] . . . . ***pusillus*** (p. 58)

– Antennal segment IV with three sense cones 17

17 Antennal segments IV–VI sub-glucose, sharply constricted to basal neck and often irregular in profile, segment IV less than 1·5 times as long as wide (Text-figs 37, 38) [eastern U.S.A.] . . . . . ***hindsi*** (p. 53)

– Antennal segments not sharply constricted at base, segment IV more than 1·5 times as long as wide (Text-fig. 41) [Florida, Texas]. . . . . ***longilabris*** (p. 55)

18 Postocellar setae usually longer than ocellar triangle (Text-fig. 22).
Antennal segment III with two or three sense cones, IV with three sense cones

(Text-figs 30, 31); pronotal epimeral sutures usually not complete [eastern U.S.A., Brazil] . . . . . ***tarsalis*** (p. 59)

– Postocellar setae shorter than ocellar triangle 19

19 Pronotal epimeral sutures not complete.
Antennal segment IV with four sense cones [Brazil] . . . ***setosus*** (p. 58)

– Pronotal epimeral sutures complete 20

20 Tube dark brown; setae B_1 on tergite IX scarcely 0·9 times as long as tube; antennal segment IV with three sense cones (Text-fig. 40); ♂ with no glandular area on sternite VIII (Text-fig. 49) [eastern U.S.A., Cuba] . . . ***dissimilis*** (p. 51)

– Tube yellow, much paler than tergites VII–VIII; setae B_1 on tergite IX at least 1·1 times as long as tube; antennal segment IV with four sense cones; ♂ not known [eastern U.S.A.] . . . . . ***forticornis*** (p. 52)

21 Setae B_1 on tergite IX clearly expanded at apex 22

– Setae B_1 on tergite IX with apices bluntly rounded to softly pointed . . . 27

22 Median setae on tergites III–VII scarcely 10 μm long; tergites III–VII with two pairs of wing retaining setae.
♂ with glandular area occupying most of sternite VIII 23

– Median setae on tergites III–VII more than 30 μm long; wing retaining setae present or absent 24

23 Antennal segment III more than 3·2 times as long as wide (Text-fig. 43); abdominal segment II darker than III–V or pterothorax [Brazil] . . ***citricornis*** (p. 49)

– Antennal segment III less than 2·5 times as long as wide; body colour mainly brown but segments I–II and lateral margins of III yellow [eastern U.S.A.] ***pettiti*** (p. 58)

24 Tergites III–VII with no wing retaining setae.
Abdomen as brown as tube; ♂ with glandular area on sternite VIII divided medially (Text-fig. 47) [eastern U.S.A., Mexico, Trinidad]. . . ***batesi*** (p. 48)

– Tergites III–VII with two pairs of wing retaining setae 25

25 Abdomen yellow with brown markings medially on each tergite, in contrast to dark brown tube.
♂ with glandular area transversely narrow and close to anterior margin of sternite VIII [Florida, North Carolina] . . . . . ***watsoni*** (p. 62)

– Abdomen brown 26

26 Abdominal segment II darker than median abdominal segments; ♂ with glandular area occupying most of sternite VIII [Brazil] . . . . ***hemimeres*** (p. 53)

– Abdomen and tube uniformly brown; ♂ with glandular area transversely narrow near anterior margin of sternite VIII with a row of accessory setae behind it (Text-fig. 45) [Brazil] . . . . . ***bisetosus*** (p. 49)

27 Pronotal anteroangular setae very small, less than 0·3 times as long as posteroangular setae (Text-fig. 27) 28

– Pronotal anteroangular setae at least 0·5 times as long as posteroangulars . . 29

28 Head and tube yellow; antennal segment IV with four sense cones; ♂ with glandular area transversely narrow near anterior margin of sternite VIII; only micropterae known [Brazil] . . . . . ***peccans*** (p. 57)

– Head and tube brown; antennal segment IV with three sense cones; ♂ not known; only macropterae known [Brazil] . . . . . ***alarius*** (p. 43)

29 Fore femora yellow but tibiae dark brown; head yellow; tube brown with basal third yellow [Brazil] . . . . . ***cruralis*** (p. 50)

– Colour different, tibiae not darker than femora 30

30 Pterothoracic ventrolateral setae with apex expanded, pterothoracic femora each with one major seta with expanded apex; at least some major setae with apices strongly asymmetric (Text-fig. 21).
♂ with glandular area occupying anterior half of sternite VIII, with one or more

setae arising between glandular area and margin [eastern U.S.A., Panama] ***osborni*** (p. 57)

– Pterothoracic ventrolateral and all femoral setae small and acute at apex . . 31

31 Fore tarsal tooth absent or less than 5 μm long in both sexes 32

– Fore tarsal tooth at least 10 μm long, frequently well developed 35

32 Head dark brown, metanotum brown, pro- and mesothorax yellow, also anterior abdominal segments; antennal segments III–VIII brown [Brazil] . ***nigriceps*** (p. 56)

– Body colour different 33

33 Fore tarsal tooth distinct, 3–5 μm long [Brazil, Cuba] ***costalimai*** (p. 50) and ***fuscipennis*** (p. 52)

– Fore tarsal tooth usually not apparent, less than 3 μm long 34

34 Glandular area of ♂ transversely narrow, across middle of sternite VIII (text-fig. 46); maxillary stylets deeply retracted into head, reaching a point 0·65 to 0·80 from base of head to posterior margin of eye; antennal segment III with two sense cones, segment VII with pedicel relatively broad [Illinois, Virginia, Kentucky] ***genarum*** (p. 52)

– Glandular area of ♂ relatively broad, usually occupying more than half of sternite VIII (Text-fig. 50); maxillary stylets low in head, reaching a point less than 0·65 from base of head to posterior margin of eye; antennal segment III with two or three sense cones, pedicel of VII broad or slender [eastern U.S.A. to S. Brazil] ***ampliventralis*** (p. 43)

35 Antennal segment VII with pedicel flared at base; median dorsal setae of head weakly expanded [Panama] . . . . . ***umbrisetis*** (p. 61)

– Antennal segment VII with pedicel parallel-sided as on segment VI; median dorsal setae of head acute 36

36 Maxillary stylets deeply retracted into head (as in *genarum*); sternite VIII with accessory setae arranged in two irregular rows; ♂ with no glandular area on sternite VIII [Brazil] . . . . . ***simplex*** (p. 58)

– Maxillary stylets low in head (as in *ampliventralis*); sternite VIII with fewer accessory setae, arranged in a single transverse row; ♂ not known [Brazil] ***conformis*** (p. 50)

Eurythrips alarius Hood

Eurythrips alarius Hood, 1957 : 134–135. Holotype ♀, Brazil (USNM) [examined].

This species is known from a single macropterous female. The micropterae described as *peccans* are similar to this specimen but can be distinguished by means of the key above.

Specimen studied.

Brazil: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera under fallen leaves, xi. 1956 (*F. Plaumann*) (USNM).

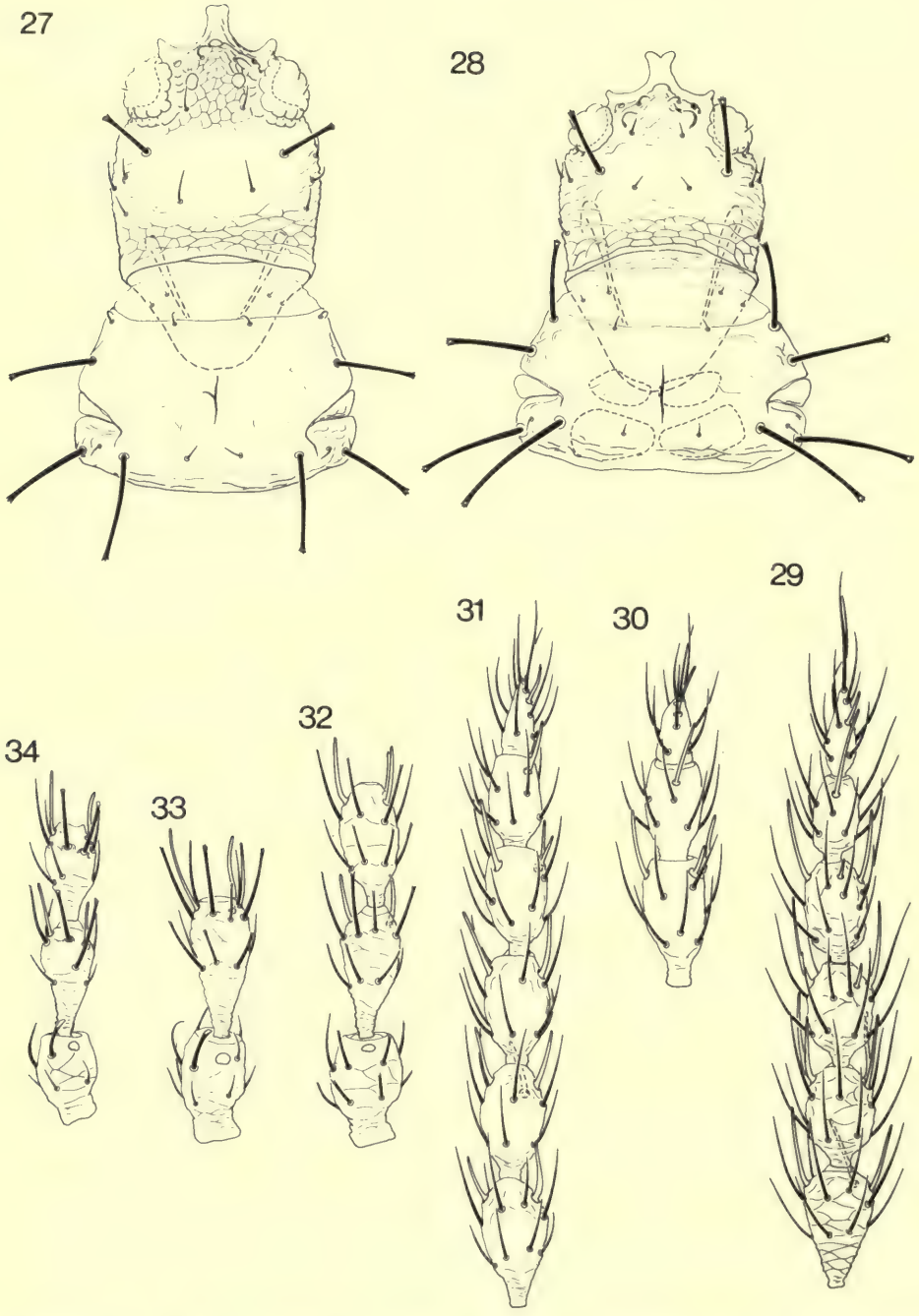
Eurythrips ampliventralis Hinds

(Text-figs 6, 8–10, 35, 36, 50)

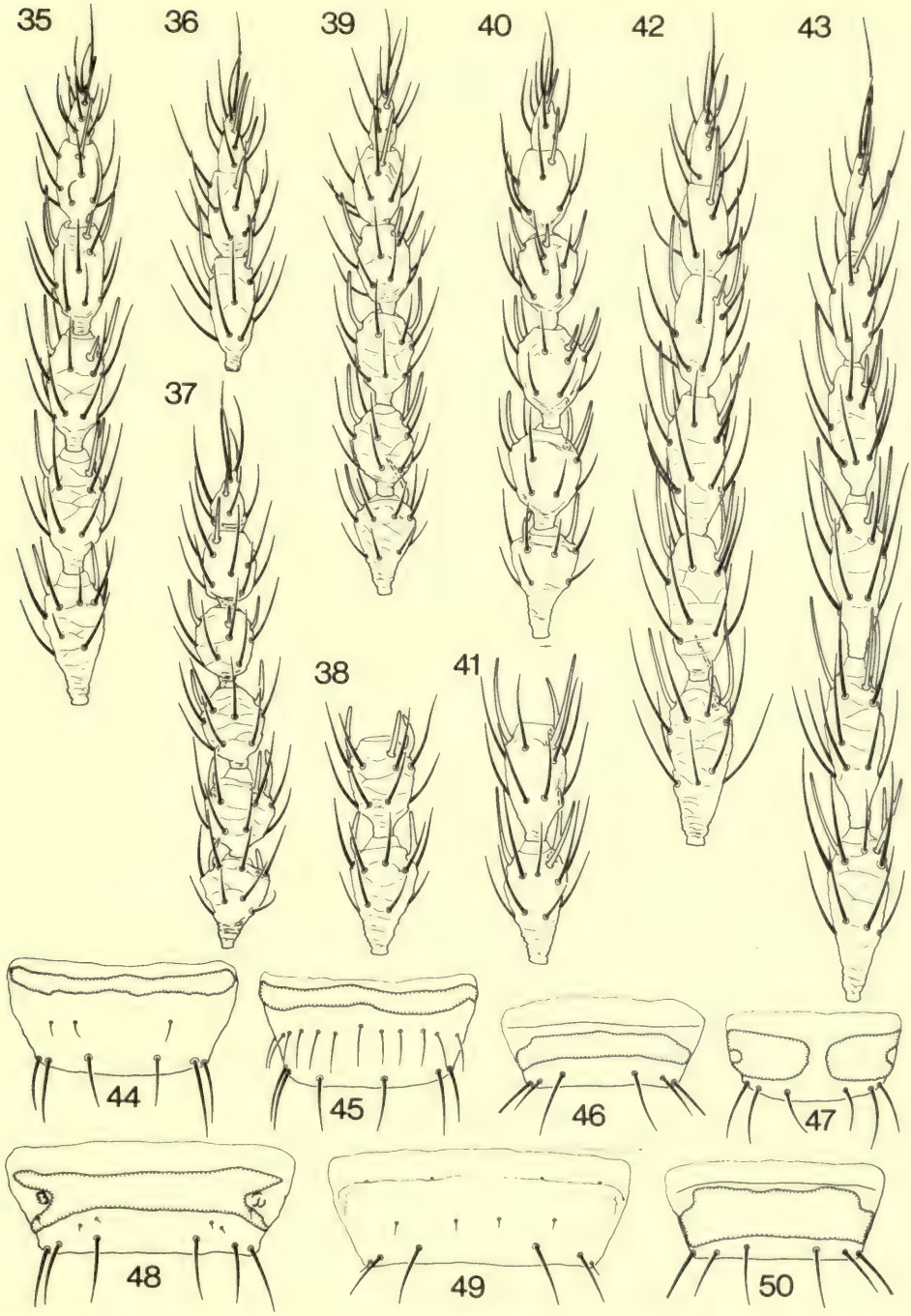
Eurythrips ampliventralis Hinds, 1902 : 202–203. Syntype ♀, U.S.A.: Massachusetts (USNM [examined].

Eurythrips cornutus Moulton, 1929 : 63–64. Holotype ♀, Cuba (CAS) [examined]. **Syn. n.**

Eurythrips amplus Hood, 1934 : 1–5. Holotype ♀, Trinidad (USNM) [examined]. **Syn. n.**



FIGS 27–34. *Eurythrips* and *Erkosothrips* species. 27, *Eurythrips peccans*; 28, *E. batesi*; 29, *E. trifasciatus*; 30, 31, *E. tarsalis* (30, *morulops* paratype); 32, *E. virginianus*; 33, *E. forticauda*; 34, *Erkosothrips subcalvus*.



FIGS 35–50. *Eurythrips* species. 35, 36, ***ampliventralis*** (36, *cornutus* holotype); 37, 38, *hindsi* macropterae (37 from Maryland, 38 from Tennessee); 39, *tristis*; 40, *dissimilis*; 41, *longilabris*; 42, *elongatus*; 43, *citricornis*; 44–50, sternite VIII of ♂ to show glandular area of (44) *forticauda*, (45) *bisetosus*, (46) *genarum*, (47) *batesi*, (48) *tarsalis*, (49) *dissimilis*, (50) ***ampliventralis***.

Eurythrips conjunctus Hood, 1934 : 63–66. Holotype ♀, PANAMA (USNM) [examined]. **Syn. n.**
Eurythrips connatus Hood, 1938 : 378–380. Holotype ♀, U.S.A.: Florida [examined]. **Syn. n.**
Eurythrips disjunctus Hood, 1941 : 153–157. Holotype ♀, U.S.A.: New York (USNM) [examined]. **Syn. n.**

The type-series of the nominal species listed above were as follows: *ampliventralis* 5 ♀ micropterae; *cornutus* 2 ♀ macropterae; *amplus* 1 ♀ macroptera; *conjunctus* 2 ♀ macropterae, 3 ♀, 8 ♂ micropterae; *connatus* 1 ♀ microptera, *disjunctus* 9 ♀ macropterae, 54 ♀, 28 ♂ micropterae. Hood indicated that the pedicel of antennal segment seven of *amplus* was stouter than that of *ampliventralis*, but this is not true of the syntype female from Hinds collection listed below. The original description of *conjunctus* contains the same erroneous comparison, but surprisingly this species was not compared to *amplus*. Moreover *connatus* was compared only to *conjunctus*. When Hood described *disjunctus* he claimed that this species could be distinguished by the narrow pedicel of antennal segment seven although this statement appears to contradict his earlier interpretation of *ampliventralis*. These nominal species have never been compared to each other at one time. The variation as interpreted here, is very confusing but there is no good reason for distinguishing as distinct species any of the specimens listed below from as far apart as Iowa and southern Brazil.

Stannard (1968), following Hood, stressed the number of sense cones on the third antennal segment. However, this character is variable in *ampliventralis* even within populations. Some individuals have a single sense cone on the outer surface of this segment whilst others from the same locality have two sense cones, one dorsolateral and the other dorsoventral (Text-figs 35, 36). Moreover, whereas the sense cone on the inner surface of segment three is relatively constant in size the two on the outer surface are variable, the dorsal one frequently being thinner and/or shorter. The holotype of *connatus* has two sense cones on the third segment of the left antenna but three fully developed sense cones on the right antenna.

The width of the pedicel of the seventh antennal segment has also been used by both Hood and Stannard for distinguishing between species. Most of the specimens listed below can be placed into one of two groups determined by the ratio: *width of pedicel VII/width of pedicel VI*. Specimens with this ratio from 1·4 to 2·5 might be called *ampliventralis*, and specimens with this ratio 1·0 to 1·3 might be called *disjunctus* (Text-figs 35, 36). However, the widths of these pedicels sometimes vary independently with the result that some individuals are intermediate. Moreover, both forms have been collected together at several sites in both North America and the Neotropics. Since this pedicel character is not correlated with the number of sense cones on the third antennal segment, and moreover the glandular area on sternite eight of the males does not differ between the two groups, it seems best to regard the variation in antennal structure as intraspecific.

The shape of the head is variable in *ampliventralis*, but this is only partly correlated with the degree of wing development. Macropterae tend to have longer heads and they often have a small tooth behind each eye (Text-figs 8–10). This

tooth is well developed in specimens which have been studied from Cuba, southern Brazil and New York, but it is not visible in a macroptera from Texas and is visible on one side only in a specimen from Illinois. Equally problematical is the variation in the fore tarsal tooth. This tooth is not visible in most specimens of either sex, but very rarely a small tooth can be discerned although this could be due to variation in orientation of the specimen. Other characters which have been found to be equally unreliable for species definition within the *ampliventralis*-group include details of antennal or body colour and the relative length of the tube.

Several other nominal species are closely related to *ampliventralis* but are excluded from that species for the present despite doubts concerning their status. The Brazilian species *simplex* appears to be distinct, but *umbrisetis* and *conformis*, each with a well defined fore tarsal tooth, and *costalimai* and *fuscipennis*, each with a small tooth, are possibly only local variants of *ampliventralis*. The male is unknown in all four of these species. In *genarum* the glandular area on sternite eight of the males is transverse and narrow. However, the glandular area of a few of the males grouped as *disjunctus* in Hood's collection are not as broad as typical *ampliventralis* nor as narrow as typical *genarum* (Text-figs 46, 50). Despite the difference in position of the maxillary stylets indicated in the key above it is possible that *genarum* is not a good species.

Specimens studied.

U.S.A.: Massachusetts, Amherst, 1 ♀ syntype of *ampliventralis*, ix. 1899 (USNM); New York, Tompkins Cty., holotype ♀ macroptera of *disjunctus* with 8 ♀ macropterae, 30 ♀, 19 ♂ micropterae (all paratypes), also 5 ♀ macropterae, 14 ♀, 7 ♂ micropterae determined as *connatus* by Hood, also 1 ♂ in Hood's box of *ampliventralis* (USNM); Virginia, Natural Bridge, xi. 1940, 5 ♀, 4 ♂ paratypes of *disjunctus*, 1 ♀ determined as *connatus* by Hood, also 1 ♀ in Hood's box of *ampliventralis* (USNM); V., Lexington, x–xi. 1940, 5 ♀ paratypes of *disjunctus*, also 16 ♀, 4 ♂ in Hood's box of *ampliventralis* (USNM); V., Falls Church and Mt Vernon, 35 ♀, 20 ♂ micropterae (*F. Andre*) (BMNH); North Carolina, 1 ♀, iv. 1939 (BMNH); Iowa, Ottumwa, 20 ♀, 9 ♂ (*F. Andre*) (BMNH); North Dakota, Grand Forks Cty, 2 ♀, v. 1962 (USNM); N.D., Barnes Cty and Wool Lake, 2 ♀ (BMNH); Illinois, Pulaski, 1 ♀ macroptera, v. 1909 (USNM); I., Union Cty, 6 ♀ micropterae, x. 1970 (*L. A. Mound*) (BMNH); Tennessee, Clarkesville, 2 ♀ (USNM); Missouri, 2 ♀, 1 ♂, v. 1937 (*F. Andre*) (BMNH); Georgia, Rabua Cty, 1 ♀, iii. 1974 (USNM); Florida, Clearwater, holotype ♀ macroptera of *connatus*, xii. 1937 (Hood); F., Cottondale, 1 ♀ macroptera, 5 ♂ micropterae, iii. 1950; F., Big Pine Key, 1 ♂, xii. 1950; F., Ft Lauderdale, 1 ♀, iv. 1974 (USNM); F., Miami, 3 ♀, ix. 1938 (BMNH); Texas, Palacios, iii. 1939, 7 ♀, 1 ♂ micropterous paratypes of *disjunctus*, 1 ♀ macroptera with 3 ♀, 3 ♂ micropterae in Hood's box of *ampliventralis* (USNM); California, 3 ♀, 1 ♂ (*F. Andre*) (BMNH); New Mexico, Espanola, 1 ♀, iii. 1939 (BMNH).

Mexico: Tampa, 1 ♀, vi. 1943 (BMNH). Panama: Barro Colorado I., holotype ♀ macroptera of *conjunctus* with 1 ♀ macroptera, 2 ♀, 5 ♂ micropterae (all paratypes) (USNM, 1 ♀ BMNH). Cuba: Baragua, holotype ♀ macroptera of *cornutus*, iv. 1927 (CAS); ♀ paratype macroptera with identical data (BMNH). Trinidad: St Joseph,

holotype ♀ macroptera of *amplus*, iii. 1918 (*C. B. Williams*) (USNM); Curepe, 3 ♀ micropterae, xi. 1970 (*L. A. Mound*) (BMNH). Brazil: Santa Catarina State, 3 ♀ macropterae, v. 1949 (*F. Plaumann*) (USNM).

Eurythrips batesi (Watson)

(Text-figs 28, 47)

Glyptothrips batesi Watson, 1935 : 56–57. LECTOTYPE ♀, U.S.A.: Florida (FSAC), here designated [examined].
Eurythrips batesi (Watson) Hood, 1941 : 163.

This species was described from 'several hundred apterous [sic] females and a single winged one, and many males'. Hood (1941 : 163) in a footnote referred to a slide which he had labelled 'holotype', and it is this specimen which is here designated lectotype. Stannard (1968 : 416) was unable to locate this specimen in the Watson collection because, unknown to him, it had remained on loan in the Hood collection where the present author studied it in 1975. Watson included specimens in his type-series from Florida, Georgia and Tennessee, but the original series comprised more than one species. Stannard records *batesi* from most of the states between southern Illinois, Maryland, Florida and Texas, and in addition records a possible variant from New Mexico, Mexico and Jamaica. As indicated below the present author has also collected *batesi* in Trinidad. In contrast to Watson's description neither Stannard nor the present author have seen macropterae, and the males and females are micropterae not apterae.

Specimens studied.

U.S.A.: Florida, Alachua Cty, Devils Mill Hopper, lectotype ♀ from dead leaves, 24.xii.1933 (*J.R.W.–B.F.*) (FSAC); F., Quincy, 1 ♀, x. 1930; F., Gainesville, 1 ♀, i. 1932; F., Ocala Forest, 3 ♀, xi. 1933; F., Jena, 1 ♂, ii. 1934, all apparently from Watson's syntype-series (USNM); F., Alachua Cty, 5 ♀, 3 ♂, 1936–39; F., Homestead, 5 ♀, iii. 1939; F., Winter Park, 6 ♀, iii. 1941 (USNM); F., Mariana, 4 ♀, 1 ♂ in moss, iii. 1933 (BMNH); Virginia, Falls Church, 1 ♀, ix. 1944; V., Arlington, 4 ♀, 1 ♂, x. 1939 (BMNH); V., Natural Bridge, 6 ♀, 7 ♂, xi. 1940 (USNM); Maryland, Beltsville, 2 ♀, 2 ♂ in *Sphagnum*, i. 1945 (BMNH); Delaware, Newark, 2 ♀, 2 ♂, iv. 1951 (BMNH).

Mexico: 1 ♀ with no data, ex Floyd Andre (BMNH). Trinidad: various localities near Curepe and Tunapuna, 45 ♀, 30 ♂ in leaf litter, 1970–72 (*L. A. Mound & B. R. Pitkin*) (BMNH).

Eurythrips bifasciatus (Hood) **comb. n.**

Porcothrips (?) *bifasciatus* Hood, 1954 : 37–38. Holotype ♀, Brazil (USNM) [examined].

This species is similar to *Eurythrips musivi*. It is known only from a single specimen.

SPECIMEN STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera, viii. 1952 (*F. Plaumann*) (USNM).

Eurythrips bisetosus (Hood) comb. n.

(Text-fig. 11)

Porcothrips (?) *bisetosus* Hood, 1954 : 35–36. Holotype ♀, BRAZIL (USNM) [examined].

This species was described from eight males and eight females, all micropterae. Although described in *Porcothrips* these specimens are similar to the micropterae of *Eurythrips hemimeres*.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ micropterа with 7 ♂, 6 ♀ paratypes, viii. 1952 (*F. Plaumann*), also approximately 60 specimens of both sexes with similar data collected 1953–54 (USNM).

Eurythrips citricollis Hood

Eurythrips citricollis Hood, 1941 : 240–243. LECTOTYPE ♀ macroptera, U.S.A.: Florida (USNM), here designated [examined].

The type-series of this species comprised three macropterous and eleven micropterous females. Although a 'paratype' was referred to in the original description no holotype was designated. The lectotype designated here is a female macroptera labelled 'holotype' by Hood. The male is still unknown.

SPECIMENS STUDIED.

U.S.A.: Florida, Winter Park, lectotype ♀ macroptera under fallen pine needles, 11.iii.1941 (*M. J. Westfall*), with 2 ♀ macropterae, 10 ♀ micropterae bearing identical data (USNM).

Eurythrips citricornis (Hood) comb. n.

(Text-figs 12, 43)

Porcothrips (?) *citricornis* Hood, 1954 : 36–37. Holotype ♀, BRAZIL (USNM) [examined].
Eurythrips occipitalis Hood, 1957 : 139–140. Holotype ♀, BRAZIL (USNM) [examined]. **Syn. n.**

Hood described each of these two species from two micropterous females. The head is partially sculptured (Text-fig. 12), but the setae on the basal antennal segments are acute, and unlike several *Erkosothrips* and *Copiothrips* species the pterothoracic ventrolateral setae are also acute. Hood stated that *occipitalis* was 'easily distinguished by the large, knobbed, occipital setae which are almost equal to the postoculars'. This, however, is true only of the holotype because one of the

occipital setae on the paratype is small and blunt. The occipital setae of *Eurythrips tristis* are also shown below to be variable. The specimens of *citricornis* listed below all have the occipital setae short and acute, and moreover, the colour of the tibiae and the sculpture of the head and pelta are variable. The type-specimens of *occipitalis* are therefore interpreted here as representing a dark form of *citricornis*.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ of *citricornis* with 1 ♀ paratype micropterae, viii. 1952 (*F. Plaumann*); 12 ♀, 1 ♂ with similar data 1953–55; holotype ♀ microptera of *occipitalis* with similar data, vii. 1955 and 1 ♀ paratype, viii. 1955 (USNM).

Eurythrips conformis Hood

Eurythrips conformis Hood, 1957 : 136–137. Holotype ♀, BRAZIL (USNM) [examined].

This species was described from nine micropterous females. It appears to be closely related to *costalimai* which is known from a single macropterous female. The variation in the group of species closely related to *ampliventralis* requires further study.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ microptera from fallen leaves, ix. 1954 (*F. Plaumann*), with 6 ♀ micropterous paratypes bearing similar data but collected between vii. 1953 and x. 1955 (USNM).

Eurythrips costalimai Hood

Eurythrips costalimai Hood, 1950 : 99–102. Holotype ♀, BRAZIL (USNM) [examined].

This species is very similar to *conformis*, differing mainly in the size of the fore tarsal tooth and the shorter setae on the abdominal tergites. The importance of these differences is difficult to assess because *conformis* is known only from micropterae and *costalimai* from a single macroptera. Both characters are known to be related to the degree of wing development in certain groups of Thysanoptera. The unique holotype of *fuscipennis* also keys out with *costalimai* and these two nominal species require further study and comparison with other members of the *ampliventralis*-group.

SPECIMEN STUDIED.

BRAZIL: Jacarepagua [Rio de Janeiro], holotype ♀ macroptera on *Andropogon condensatus*, 18.v.1948 (*Hood*) (USNM).

Eurythrips cruralis Hood

Eurythrips cruralis Hood, 1957 : 140. Holotype ♀, BRAZIL (USNM) [examined].

The three female micropterae on which this species was based can be distinguished

from the other members of the *ampliventralis*-group by the unusual colour of the legs and tube.

SPECIMEN STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ microptera from fallen leaves, viii. 1952 (*F. Plaumann*), with 1 ♀ paratype bearing similar data except viii. 1955 (USNM).

Eurythrips dissimilis Hood

(Text-figs 13, 40, 49)

Eurythrips dissimilis Hood, 1938 : 365–366. Holotype ♀, U.S.A.: Florida (USNM) [examined].

This species was described originally from one micropterous female. Both *dissimilis* and *forticornis* appear to be related to the *hindsi*-group but they are unusual in having the epimeral sutures complete.

SPECIMENS STUDIED.

U.S.A.: Florida, Sebring, holotype ♀ microptera swept from grass, 7.iv.1938 (*J. W. H. Rehn*) (USNM); Texas, Palacios, 26 ♀, 20 ♂ on grass, i.iv.1939 (USNM); Virginia, Mt Vernon, 1 ♂ from *Andropogon*, ii. 1940 (*F. Andre*) (BMNH); New Jersey, Cape May, 1 ♀, x. 1949 (USNM).

MEXICO: Axtla, 1 ♀, v. 1939 (USNM). CUBA: Ceiba Mocha, Matunzas, 1 ♂, vii. 1940 (USNM).

Eurythrips elongatus Hood

(Text-figs 14, 42)

Eurythrips elongatus Hood, 1957 : 140–141. Holotype ♀, BRAZIL (USNM) [examined].

This species was described from two females and one male, all micropterae. These differ from other members of the genus in having a relatively long, slender head.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ microptera under fallen leaves, vii. 1953 (*F. Plaumann*), also 1 ♀, 1 ♂ micropterae with similar data except ii. 1954 (USNM).

Eurythrips forticauda (Hood) **comb. n.**

(Text-figs 15, 33, 44)

Porcothrips (?) *forticauda* Hood, 1954 : 34–35. Holotype ♀, BRAZIL (USNM) [examined].

This is one of the species which appears to be intermediate between *Eurythrips* and *Erkosothrips*. The head is weakly reticulate but the setae on the basal

antennal segments and the pterothoracic ventrolateral setae have expanded apices (Text-fig. 43). Moreover the meso- and metathoracic femora also bear a single stout seta with an expanded apex as in *osborni*. The type-series consisted of 26 female and seven male micropterae.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ microptera with 22 ♀, 6 ♂ paratype micropterae, vii. 1952 (*F. Plaumann*), also more than 70 further specimens with similar data, 1953–54 (USNM, 1 ♀, 1 ♂ BMNH).

Eurythrips forticornis Hood

Eurythrips forticornis Hood, 1939 : 593–594. Holotype ♀, U.S.A.: Alabama (USNM) [examined].

This species is similar to *dissimilis* in the form of the head and smooth pronotum. However, the setae on the ninth abdominal tergite are longer, and the tube coloured differently. The species was based on a single female.

SPECIMENS STUDIED.

U.S.A.: Alabama, Mobile, holotype ♀ microptera on dead grass, 17.xii.1938 (*Hood*); Virginia, New Market, 1 ♀ microptera on grass, 5.i.1941 (*L. C. Pettit*) (USNM).

Eurythrips fuscipennis Moulton

Eurythrips fuscipennis Moulton, 1929 : 65–66. Holotype ♀, CUBA (CAS) [examined].

This species is referred to under *costalimai* with which species it needs to be further compared.

SPECIMEN STUDIED.

CUBA: Baragua, holotype ♀ macroptera from unknown host plant, 15.iv.1927 (*L. C. Scaramuzza*) (CAS).

Eurythrips genarum Hood

(Text-fig. 46)

Eurythrips genarum Hood, 1957 : 54–55. Holotype ♀, U.S.A.: Virginia (USNM) [examined].
Eurythrips constrictus Stannard, 1958 : 272–273. Holotype ♀, U.S.A.: Kentucky (INHS) [not examined]. **Syn. n.**

The original description of this species clearly states 'two sense cones on outer surface of segment three of antennae'. However, this statement is not true of the holotype, nor of the five female and one male paratypes which have been studied. Antennal segment III of all the specimens listed below bears only two sense cones, one on the inner and one on the outer surface. As a result *constrictus* cannot be distinguished from *genarum*. This species is very similar to *ampliventralis*

and can only be distinguished by means of the poor characters indicated in the key. The base of antennal segment VIII is moderately thickened and well within the range of variation of *ampliventralis*, and the fore tarsal tooth is not apparent. It seems likely that *genarum* will eventually be shown to be a local variant of *ampliventralis*. The type-series of *genarum* consisted of eight female and one male micropterae from Virginia, and the type-series of *constrictus* comprised one female with six male micropterae from Kentucky and 21 female with 15 male micropterae from Illinois.

SPECIMENS STUDIED.

U.S.A.: Virginia, Fairfax Cty, holotype ♀ microptera of *genarum* on *Andropogon* with 5 ♀, 1 ♂ paratypes, 5.i.1941 (*L. C. Pettit*) (USNM); V., Mt Vernon, 1 ♀, 1 ♂ on *Andropogon*, 19.xii.1944 (*F. Andre*); V., Falls Church, 2 ♂ on sedges, 31.x.1943 (*F. Andre*) (BMNH); Illinois, Zenith, 1 ♂ determined as *constrictus* by L. J. Stannard, 18.iii.1966 (INHS).

Eurythrips hemimeres Hood

(Text-fig. 16)

Eurythrips hemimeres Hood, 1957 : 142. Holotype ♀, BRAZIL (USNM) [examined].

Judging from the type-series of 155 specimens this was the most abundant of the many species of *Eurythrips* collected by F. Plaumann in southern Brazil. It appears to be a member of the *batesi*-group of species, and has expanded apices to the setae on the ninth tergite but a large and complete glandular area on sternite eight of the male.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera from fallen leaves, iv. 1954 (*F. Plaumann*), also 149 specimens including ♀ ♂ micropterae with similar data except collection dates, viii. 1952 to x. 1955 (USNM, 1 ♀, 1 ♂ micropterae BMNH).

Eurythrips hindsi Morgan

(Text-figs 17, 37, 38)

Eurythrips hindsi Morgan, 1913 : 27–28. Holotype ♀, U.S.A.: Tennessee (USNM) [examined].
Glyptothrips eddeyi Watson, 1935 : 57–58. LECTOTYPE ♀, U.S.A.: South Carolina (FSAC), here designated [examined]. **Syn. n.**

This species was described from a single micropterous female, although specimens have now been studied from most of the states between Illinois, Maryland, South Carolina and Arkansas. Over most of this area specimens of *hindsi* have the median antennal segments exceptionally short and broad (Text-fig. 37), but some specimens from Tennessee have longer antennae (Text-fig. 38). The species known as *longilabris* (=*harti*) is closely related and may be merely a southern variant,

but this species itself appears to grade into the *modestus*-group from the Caribbean.

The *hindsi*-group also includes *tristis* and *tarsalis*. The postocellar setae are usually short in both *hindsi* and *tristis*, although these setae are almost always elongate in *tarsalis*. The postocular setae are acuminate in *hindsi*, expanded apically in *tristis* but softly pointed in *tarsalis*. Moreover these setae are acuminate in the *longilabris* holotype but softly pointed in the *harti* holotype although these two are treated here as one species.

The syntypes of *eddeyi*, labelled paratypes by Watson, have been found to contain at least seven species. A lectotype is selected and listed below under specimens studied for the purposes of synonymy. The other syntypes are as follows.

ampliventralis: 1 ♂, broom sedge tops, Florida, Gainesville, ii. 1934 (USNM); 1 ♂, cabbage, no locality, ii. 1931 (FSAC).
osborni: 1 ♂, 1 ♀, swamp grass, South Carolina, Clemson Coll., ii. 1931 (FSAC).
pettiti: 1 ♀, pine needles, North Carolina, Ashville, x. 1934 (FSAC).
tristis: 1 ♀, broom sedge, South Carolina, Clemson Coll., ii. 1931 (FSAC).
watsoni: 2 ♀, pine needles, North Carolina, Ashville, x. 1934 (USNM).
Malacothrips roycei: 4 ♂, 1 ♀, swamp grass, South Carolina, Clemson Coll., ii. 1931 (FSAC).

Specimens studied.

U.S.A.: Tennessee, Clarkesville, holotype ♀ microptera of *hindsi* in stool of broom sedge, 17.x.1910 (*W. E. Hinds*) (USNM); T., Hamilton Cty, 5 ♂, 7 ♀ micropterae, xi. 1939–ii. 1941 (USNM, 1 ♀ macroptera with similar data BMNH); Alabama, Escambia Cty, 5 ♀ micropterae, 1 ♀ macroptera, 1936–7 (USNM); Arkansas, no locality, 5 ♀ micropterae in dead leaves (?*F. Andre*) (BMNH); Mississippi, Lincoln Cty, 1 ♀, iii. 1938; M., McNeill, 1 ♀, 3 ♂, xii. 1934 (USNM); Ohio, Chillicothe, 8 ♀ (USNM); South Carolina, Clemson Coll., lectotype ♀ microptera of *eddeyi* with 9 ♀ paralectotypes on broom sedge, 19.ii.1931 (*B.F.*) (FSAC) (4 ♀ paralectotypes with similar data USNM); North Carolina, Ashville, 30 ♀, 10 ♂ from *Andropogon* pasture (*eddeyi* 'paratypes'), 23.x.1934 (*Jacot*) (FSAC); Virginia, Lubay, 9 ♀, i. 1941; V., Falls Church, iii. 1941 (USNM); V., Mt Vernon, 2 ♀, 1940 (BMNH); Maryland, Beltsville, 1 ♀ macroptera in moss, ix. 1945 (*F. Andre*) (BMNH); New York, Oswegatchie, 1 ♀ macroptera, ix. 1936; 1 ♀ macroptera, viii. 1932 (USNM).

Eurythrips hookae Hood

(Text-fig. 18)

Eurythrips hookae Hood, 1933 : 414–415. Holotype ♀, Panama (USNM) [examined].

The colour characteristics for this species given in the key may well be unreliable as the unique holotype macropterous female appears to be immature. The specimen is more strongly alate than the macropterae of *tristis* with a relatively longer head and larger eyes. The dorsal setae on tergite nine are long and acuminate, but the B_1 setae on tergite seven are expanded apically.

SPECIMEN STUDIED.

PANAMA: Barro Colorado I., Gatun Lake, holotype ♀ macroptera on dead grass, 26.vi.1933 (*S. J. Hook*) (USNM).

Eurythrips longilabris Watson

(Text-figs 19, 41)

Eurythrips longilabris Watson, 1921 : 36–37. Holotype ♀, U.S.A.: Florida (FSAC) [examined].
Eurythrips harti Hood, 1925 : 135–137. Holotype ♀, U.S.A.: Texas (USNM) [examined]. **Syn. n.**

These two nominal species are both known from single macropterous females. The two specimens differ from each other in details of colour and, whereas the postocular setae of the *longilabris* holotype are acuminate these setae are softly pointed in the *harti* holotype. These differences are interpreted here as variation within a single species which is related to *hindsi*.

SPECIMENS STUDIED.

U.S.A.: Florida, Gainesville, holotype ♀ macroptera of *longilabris* at light, vii. 1920 (*J.R.W.*) (FSAC); Texas, Brownsville, holotype ♀ macroptera of *harti*, from grass, 20.xi.1911 (*C. A. Hart*) (USNM).

Eurythrips modestus (Bagnall)

(Text-fig. 20)

Malacothrips modestus Bagnall, 1917 : 24–26. Holotype ♀, ST VINCENT (BMNH) [examined].
Eurythrips cinctus Hood, 1927 : 245–246. Holotype ♀, TRINIDAD (USNM) [examined]. **Syn. n.**
Eurythrips varius Moulton, 1929 : 64–65. Holotype ♀, CUBA (CAS) [examined]. **Syn. n.**
Eurythrips xanthozonus Hood, 1957 : 138–139. Holotype ♀, BRAZIL (USNM) [examined]. **Syn. n.**
Eurythrips modestus (Bagnall) Mound, 1968 : 103.

This species is evidently widespread although uncommon. The antennae are almost uniformly brown as in the related species *nigricornis*. The apices of the major setae are broadly expanded apically in the two specimens from St Vincent and Cuba, weakly expanded in the specimens from Trinidad and Panama, but almost pointed in the specimen from Brazil. The male has a large glandular area occupying most of sternite eight. The head shape is variable and the species appears to be related to *longilabris*. Three of the nominal species listed in the synonymy above were based on single macropterous females, but the description of the fourth species, *cinctus*, refers to three females including both long-winged and short-winged forms.

SPECIMENS STUDIED.

ST VINCENT: holotype ♀ macroptera of *modestus* without data (*H. H. Smith*)

(BMNH). TRINIDAD: Caura Valley, holotype ♀ macroptera of *cinctus* from grass, 20.iv.1916 (*C. B. Williams*); St Augustine, 1 ♀, 1 ♂ micropterae from soil, 1943–44 (USNM). CUBA: Baragua, holotype ♀ macroptera of *varius*, 15.iv.1927 (*C. F. Stahl*) (CAS). PANAMA: Canal Zone, Frijoles, 1 ♀ macroptera on dead vine, 7.vii.1933 (*Hood*) (USNM). BRAZIL: Para State, Belem, holotype ♀ macroptera of *xanthozonus* from grass, 2.viii.1951 (*Hood*) (USNM).

Eurythrips musivi Hood

Eurythrips musivi Hood, 1957 : 137–138. Holotype ♀, BRAZIL (USNM) [examined].

The four female macropterae on which this species was based are similar to *bifasciatus* and *striolatus*, despite the fact that the first of these was described in *Porcothrips*.

SPECIMENS STUDED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera under fallen leaves, v. 1953 (*F. Plaumann*), also 2 ♀ paratype macropterae with similar data (USNM).

Eurythrips nigriceps Hood

Eurythrips nigriceps Hood, 1957 : 141. Holotype ♀, BRAZIL (USNM) [examined].

The unique holotype of this species, a macropterous female, resembles *ampliventralis* in the form of the abdominal setae. It is readily distinguished by the brown head and yellow pronotum.

SPECIMEN STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera from fallen leaves, viii. 1955 (*F. Plaumann*) (USNM).

Eurythrips nigricornis Hood

Eurythrips nigricornis Hood, 1960 : 61–63. Holotype ♀, BRAZIL (USNM) [examined].

The type-series of this species, comprising two macropterous and 19 micropterous females with six micropterous males, was still unlabelled in 1975. These specimens were stored in the Hood collection in a bix containing a second unlabelled series, the individuals of which differed from *nigricornis* in details of colouration. The significance of colour variation in this species, and the relationship between *nigricornis* and *modestus* require further study.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera with 26 paratypes (1 ♀ macroptera, 19 ♀, 6 ♂ micropterae) from dead grasses, vi. 1957 (*F. Plaumann*) (USNM).

Eurythrips osborni Hinds

(Text-fig. 21)

Eurythrips osborni Hinds, 1902 : 203–205. Syntype ♀ ♂, U.S.A.: Massachusetts (USNM) [examined].
Eurythrips macrops Hood, 1925 : 219–220. Holotype ♀, U.S.A.: Florida (USNM) [examined]. **Syn. n.**
Eurythrips setiger Stannard, 1958 : 271–272. Holotype ♀, U.S.A.: Illinois (INHS) [examined]. **Syn. n.**

This species is readily distinguished from other species in North America by the presence of a major seta with expanded apex on the pterothoracic femora and a similar pair of setae ventrolaterally on the meso- and metathorax. The apices of the major setae on the head and pronotum are usually exceptionally asymmetric. The original description was based on eight female macropterae together with two female and five male micropterae. Hood described *macrops* from one female macroptera, and the original series of *setiger* comprised two female macropterae from Illinois, one female macroptera from Arkansas and one female macroptera with three female micropterae from Florida.

Specimens studied.

U.S.A.: Massachusetts, Amherst, on grass, 1 ♀ macroptera, 18.ix.1899, 1 ♀, 1 ♂ micropterae, 9.ix.1899, syntypes of *osborni* (*W. E. Hinds*) (USNM); Illinois, Dixon Springs, holotype ♀ macroptera of *setiger*, 30.viii.1951 (*Ross & Richards*) (INHS); New York, Covert, 1 ♂, ix. 1940 (USNM); Arkansas, Rogers, 1 ♀ paratype macroptera of *setiger*, 8.vii.1949 (*Sanderson & Stannard*) (INHS); South Carolina, Clemson College, 1 ♀, 1 ♂ micropterae on swamp grass (syntypes of *eddeyi*), ii. 1931 (FSAC); Florida, Orlando, holotype ♀ macroptera of *macrops* in grass by small lake, 4.xi.1914 (*C. B. Williams*) (USNM); F., Gainesville, 1 ♂ on dead grass (*Bratley*) (BMNH). Panama: Frijoles, 1 ♀ macroptera, 4 ♀, 5 ♂ micropterae, vii. 1933 (USNM).

Eurythrips peccans Hood

(Text-fig. 27)

Eurythrips peccans Hood, 1957 : 135. Holotype ♀, Brazil (USNM) [examined].

This species was based on 19 female and one male micropterae. These resemble the macropterous female described as *alarius* but differ in colour and the number of sense cones on the fourth antennal segment.

Specimens studied.

Brazil: Santa Catarina State, Nova Teutonia, holotype ♀ microptera with 16 ♀, 1 ♂ paratype micropterae from fallen leaves, v. 1953–x. 1955 (*F. Plaumann*) (USNM).

Eurythrips pettiti Hood

Eurythrips pettiti Hood, 1941 : 203–206. Holotype ♀, U.S.A.: Virginia (USNM) [examined].

This species may be distinguished from the other North American members of the genus by the expanded apices of the major setae on the ninth abdominal tergite and the yellow colour of the first two abdominal segments. The type-series comprised three micropterae, two females and one male, but Stannard (1968 : 420) refers to female macropterae and records the species from Illinois, Michigan, Pennsylvania, Missouri, Arkansas and North Carolina.

Specimens studied.

U.S.A.: Virginia, New Market, holotype ♀ microptera on grasses with 1 ♀, 1 ♂ paratype micropterae, 5.i.1941 (*L. C. Pettit*), also 1 ♀, 2 ♂ micropterae with similar data except iii. 1941 (USNM); North Carolina, Ashville, 1 ♀ 'paratype' of *eddeyi* in pitch and scrub pine needles, 23.x.1934 (*Jacot*) (FSAC).

Eurythrips pusillus Hood

Eurythrips pusillus Hood, 1957 : 135–136. Holotype ♀, Brazil (USNM) [examined].

This small species, which was based on one female macroptera and eight female micropterae, is related to *hindsi*. The male is unknown.

Specimens studied.

Brazil: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera in fallen leaves, ii. 1954 (*F. Plaumann*), also 6 ♀ paratype micropterae with similar data except v. 1953 to x. 1955 (USNM).

Eurythrips setosus Hood

Eurythrips setosus Hood, 1950 : 108–111. Holotype ♀, Brazil (USNM) [examined].

This species, which is a member of the *hindsi*-group, is still known only from the type-series comprising one female macroptera and three female micropterae.

Specimens studied.

Brazil: Rio de Janeiro State, Itaguai, holotype ♀ macroptera from dead branches, 22.vi.1948 (*Mendes & Lopes*); São Paulo State, Itanhaen, 2 ♀ micropterae from grasses on coast, 17.vi.1948 (*Hood & Lane*) (USMN).

Eurythrips simplex (Hood) **comb. n.**

(Text-fig. 24)

Porcothrips (?) *simplex* Hood, 1954 : 36. Holotype ♀, Brazil (USNM) [examined].

Despite its original generic placement this species is a typical member of *Eurythrips*. The original series comprised one female macroptera and five female

micropterae. Hood described the dorsal setae on the ninth abdominal tergite as 'pointed', but they are not acuminate. Using phase contrast microscopy the apices of these setae can be seen to be flattened and translucent, a condition termed 'softly pointed' in this paper.

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera with 4 ♀ paratype micropterae, viii. 1952 (*F. Plaumann*), also 5 ♀ macropterae, 40 ♀, 6 ♂ micropterae bearing similar data except for collection dates (USNM, 1 ♀ BMNH).

Eurythrips striolatus Hood

Eurythrips striolatus Hood, 1957 : 138. Holotype ♀, BRAZIL (USNM) [examined].

This species, which is known only from the type-series of four macropterous females, is similar to *musivi* and *bifasciatus*. The sculpture of the head is not robust although similar to *trifasciatus* (Text-fig. 23).

SPECIMENS STUDIED.

BRAZIL: Santa Catarina State, Nova Teutonia, holotype ♀ macroptera with 2 ♀ paratype macropterae under fallen leaves, iv. 1954 (*F. Plaumann*) (USNM).

Eurythrips subflavus Hood

Eurythrips subflavus Hood, 1950 : 102–103. Holotype ♀, BRAZIL (USNM) [examined].

This species, known only from the holotype, is recognizable by the long acuminate setae on the ninth abdominal tergite and the overall yellow colour of the body.

SPECIMEN STUDIED.

BRAZIL: Rio de Janeiro State, Itaguai, holotype ♀ microptera from grasses, 22.vi.1948 (*Hood*) (USNM).

Eurythrips tarsalis Hood

(Text-figs 22, 30, 31, 48)

Eurythrips tarsalis Hood, 1925 : 220–221. Holotype ♀, U.S.A.: Virginia (USNM) [examined].
Plectrothrips montanus Watson, 1933 : 16–18. Syntypes ♀ ♂, U.S.A. Tennessee (FSAC, USNM) [examined]. [Synonymized by Stannard, 1957 : 43.]
Eurythrips morulops Hood, 1950 : 96–99. Holotype ♀, BRAZIL (USNM) [examined]. **Syn. n.**

Large individuals of *tarsalis*, at all sites, have a stout tubercle near the inner apex of the fore tibia, although this is reduced in small individuals. The length of the head and colour of the third antennal segment varies between populations in Virginia but this does not seem to be a simple function of wing length. The specimens listed below from Brazil differ from North American specimens in the form of the terminal segments of the antennae (Text-figs 30, 31), but this is not

accepted here as representing a specific difference. This species was originally based on one female macroptera, but it has now been recorded from many of the states between North Dakota, New York, Florida and Texas.

Specimens studied.

U.S.A.: Virginia, East Falls Church, holotype ♀ macroptera of *tarsalis* at base of *Andropogon* leaves, 17.iii.1913 (*L. O. Jackson*) (USNM); V., Falls Church, 2 ♀ macropterae, 5 ♀, 6 ♂ micropterae (BMNH, USNM); V., Mt Vernon, 2 ♀ macropterae, 16 ♀, 16 ♀ micropterae (*F. Andre*) (BMNH); V., Fairfax Cty, 14 ♀, 1 ♂ micropterae; V., Luray, 1 ♀ macroptera; V., Natural Bridge, 5 ♀ macropterae, 7 ♂ micropterae (USNM); New York; Hammondsport, 7 ♀, 14 ♂; N.Y., Oswegatchie, 1 ♀ macroptera; N.Y., St Lawrence, 4 ♀, 1 ♂ (USNM); Iowa, Ottumwa, 22 ♀, 14 ♂ (*F. Andre*) (BMNH); North Dakota, Northwood, 2 ♀ (USNM); Tennessee, Gatlinburg, 1 ♀, 1 ♂ 'paratypes' of *montanus* from dead leaves on ground, 15.viii.1932 (*J.R.W.*) (USNM); Texas, Blessing, 1 ♂, iv. 1939 (USNM); Georgia, Metter, 2 ♀, iii. 1950 (USNM); North Carolina, Bent Creek, 1 ♀ bearing manuscript name, 17.iv.1935 (*Jacot*) (USNM); Florida, Clearwater, 2 ♀, 1 ♂, xii. 1937 (USNM).

Brazil: São Paulo State, Salesopolis, Boracea, holotype ♀ macroptera of *morulops* with 10 ♀, 12 ♂ paratype micropterae bearing similar data, 6.vi.1948 (*Hood*) (USNM, 1 ♀ BMNH); Para State, Belem and Santarem, 2 ♀, 1 ♂ micropterae, 1951 (USNM).

Eurythrips trifasciatus (Hood) **comb. n.**

(Text-figs 23, 29)

Porcothrips (?) *trifasciatus* Hood, 1954 : 38–39. Holotype ♀, Brazil (USNM) [examined].

The head is weakly sculptured in this species, as in *striolatus*, but the antennae are strongly sculptured (Text-fig. 29). The major dorsal setae on the ninth abdominal tergite are softly pointed, not acuminate. The species was based originally on a single female microptera.

Specimens studied.

Brazil: Santa Catarina State, Nova Teutonia, holotype ♀ microptera, viii. 1952 (*F. Plaumann*); also 70 further specimens, including ♀ macropterae and ♀ ♂ micropterae, with similar data except dates of collection (USNM).

Eurythrips tristis Hood

(Text-figs 25, 39)

Eurythrips tristis Hood, 1941 : 157–160. Holotype ♀, U.S.A.: New York (USNM) [examined].

The type-series of *tristis* comprised three female macropterae and nine female with four male 'apterae'. However, these apterae have very small wing lobes and should be referred to as micropterae despite the extreme reduction of the ocelli. This species is not included by Stannard (1968) in his key to the species

from Illinois, but specimens of *tristis* come down to '*osborni*' in that key and specimens listed below from Illinois, Kentucky and Michigan were labelled as *osborni* by Dr Stannard. (*E. setiger* Stannard is given above as a synonym of *osborni* Hinds.) The record of *osborni* from Georgia (Beckham *et al.* 1971) is probably also a misidentification of *tristis*, although the two females listed below from Georgia have longer antennae than specimens from Virginia and moreover the apices of the dorsal setae on tergite nine are not quite acuminate. Several females from Virginia, both macropterae and micropterae, have either or both of the postocellar and median dorsal (occipital) setae on the head elongate. These specimens emphasise the relationship between *tristis*, *tarsalis* and *hindsi*.

Specimens studied.

U.S.A.: New York, Oswegatchie, holotype ♀ macroptera with 2 ♀ macropterae, 5 ♀, 4 ♂ micropterae (paratypes) in dead grass, 9.ix.1940 (*Hood*); N.Y., Apulia Station, 1 ♀ paratype microptera, 11.x.1940; N.Y., Warrensburg, 3 ♀ paratype micropterae, 12.x.1940 (USNM); Illinois, Marshall, 1 ♂, v. 1949; I., Monticello, 1 ♀, v. 1940 (INHS); Kentucky, Mammoth Cave, 1 ♂, iv. 1950 (INHS); Michigan, George Res., 1 ♂, i. 1950 (INHS); Virginia, Falls Church, 16 ♀, 10 ♂ micropterae, 1944–45 (*F. Andre*); V., Four Mile Run, 1 ♀ macroptera (*F. Andre*) (BMNH); V., Natural Bridge, 1 ♂, 1 ♀ (USNM); V., Warrenton, 1 ♀ macroptera, i. 1941 (USNM); Georgia, no locality, 1 ♂ in humus, 15.xii.1940 (?*F. Andre*) (BMNH); G., Jasper Co., in peach orchard soil, 2 ♀ macropterae, one bearing a manuscript name (*W. F. Turner*) (CAS); South Carolina, Clemson College, 1 ♀ 'paratype' of *eddeyi* from broom sedge, ii. 1931 (FSAC); Florida, Cottondale, 2 ♀, iii. 1950 (USNM).

Eurythrips umbrisetis Hood

Eurythrips umbrisetis Hood, 1933 : 415–416. LECTOTYPE ♀, Panama (USNM), here designated [examined].

This species was based on two micropterous females, but the description failed to designate a holotype. The specimen here designated as lectotype is the specimen labelled by Hood as 'holotype'. The species belongs to the *ampliventralis*-group but has a well developed fore tarsal tooth.

Specimens studied.

Panama: Canal Zone, Frijoles, lectotype ♀ microptera with 1 ♀ paralectotype microptera, dead leaves of *Panicum maximum*, 18.vii.1933 (*H. H. Hood & S. J. Hook*) (USNM).

Eurythrips virginianus Hood

(Text-figs 7, 26, 32)

Eurythrips virginianus Hood, 1952 : 77–80. Holotype ♀, U.S.A.: Virginia (USNM) [examined].

This species resembles *Erkosothrips* in the well developed sculpture on the head and the presence of setae with expanded apices on the basal antennal segments.

However, the pterothoracic ventrolateral setae are small and acute. Stannard records the species from Illinois, Connecticut, and Tennessee. No macropterae are known and the original series comprised seven female with one male micropterae.

SPECIMENS STUDIED.

U.S.A.: Virginia, New Market, holotype ♀ with 4 ♀, 1 ♂ paratypes, 16.iii.1941 (*L. C. Pettit*) (USNM); V., Falls Church, 8 ♀, 8 ♂ in moss, xi. 1944 and x. 1945 (*F. Andre*) (BMNH); Iowa, White, 2 ♀, xii. 1935 (*F. Andre*) (BMNH).

Eurythrips watsoni Hood

Eurythrips watsoni Hood, 1941 : 161–163. Holotype ♀, U.S.A.: Florida (USNM) [examined].

The type-series of this species, comprising six female and two male micropterae, were all originally syntypes of *batesi* Watson. Moreover two of the syntypes of *eddeyi* Watson are also recognizable as *watsoni*. No macropterae are known but Stannard (1968 : 423) records the species from Illinois, Pennsylvania, Kentucky, Virginia and North Carolina.

SPECIMENS STUDIED.

U.S.A.: Florida, Trenton, holotype ♀ microptera with 1 ♀, 2 ♂ paratypes from pine needles, 8.v.1934 (*A. N. Tissot*); 1 ♀ paratype 'probably from Florida' (USNM); North Carolina, Ashville, 2 ♀ micropterae, 'paratypes' of *eddeyi* from pitch and scrub pine needles, 23.x.1934 (*A. Jacot*) (USNM).

TERTHROTHRIPS Karny

Terthrothrips Karny, 1925 : 78. Type-species: *Phloeothrips sanguinolentus* Bergroth, by monotypy.

The genus *Terthrothrips* cannot be distinguished satisfactorily from *Eurythrips*. Stannard (1955) separated these two genera by means of the following couplet in his key: 'Antennae especially long' or 'Antennae moderate in length'. However, not all *Terthrothrips* species have exceptionally long antennae. The length/width ratio for the third antennal segment ranges from 4 : 1 (*bullifer*, *fuscatus*, *peltatus*, *percultus*, *unicinctus*), more than 3·5 : 1 (*brunneus*, *irretatus*) to less than 3 : 1. In fact *viduus* (2·5 : 1) and *bucculentus* (2·9 : 1) both have short heads with the maxillary stylets low in the head, and both species are quite similar to *Eurythrips bifasciatus* (Hood). *Terthrothrips* is at present being studied at the Illinois Natural History Survey, but a complete reassessment of the related genera is needed.

Terthrothrips is used here for a group of species with rounded cheeks which are deeply incut behind bulbous eyes. In contrast *Eurythrips* species generally have the cheeks straighter and the compound eyes smaller. *Terthrothrips* species are usually macropterous whereas *Eurythrips* species are usually short-winged. The differences in head form may be related to this, *Terthrothrips* being an extreme alatoid condition and *Eurythrips* a derived apteroid condition. *Eurythrips* has

radiated successfully in North America. In contrast, 24 of the species listed in *Terthrothrips* are known only from Santa Catarina State, Brazil, whilst the other three species are recorded from Venezuela (*magnicauda*), Trinidad (*gracilicornis*) and Panama (*clavivestis*). Priesner (1951 : 365) referred *clavivestis* and *gracilicornis* to *Porcothrips* but they are both retained here in *Terthrothrips*.

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6. OKADA, T. Diptera from Nepal. Cryptochaetidae, Diastatidae and Drosophilidae. Pp. 129: 328 text-figures. May, 1966. £3.
7. GILIOMEE, J. H. Morphology and Taxonomy of Adult Males of the Family Coccidae (Homoptera: Coccoidea). Pp. 168: 43 text-figures. January, 1967. £3.15.
8. FLETCHER, D. S. A revision of the Ethiopian species and a check list of the world species of *Cleora* (Lepidoptera: Geometridae). Pp. 119: 14 plates, 146 text-figures, 9 maps. February, 1967. £3.40.
9. HEMMING, A. F. The Generic Names of the Butterflies and their type-species (Lepidoptera: Rhopalocera). Pp. 509. £8.50. Reprinted 1972.
10. STEMPFFER, H. The Genera of the African Lycaenidae (Lepidoptera: Rhopalocera). Pp. 322: 348 text-figures. August, 1967. £8.
11. MOUND, L. A. A review of R. S. Bagnall's Thysanoptera collections. Pp. 172: 82 text-figures. May, 1968. £4.
12. WATSON, A. The Taxonomy of the Drepaninae represented in China, with an account of their world distribution. Pp. 151: 14 plates, 293 text-figures. November, 1968. £5.
13. AFIFI, S. A. Morphology and Taxonomy of Adult Males of the families Pseudococcidae and Eriococcidae (Homoptera: Coccoidea). Pp. 210: 52 text-figures. December, 1968. £5.
14. CROSSKEY, R. W. A Re-classification of the Simuliidae (Diptera) of Africa and its Islands. Pp. 198: 1 plate, 331 text-figures. July, 1969. £4.75.
15. ELIOT, J. N. An analysis of the Eurasian and Australian Neptini (Lepidoptera: Nymphalidae). Pp. 155: 3 plates, 101 text-figures. September, 1969. £4.
16. GRAHAM, M. W. R. DE V. The Pteromalidae of North-Western Europe (Hymenoptera: Chalcidoidea). Pp. 908: 686 text-figures. November, 1969. £19.
17. WHALLEY, P. E. S. The Thyrididae of Africa and its Islands. Pp. 198: 68 plates, 15 text-figures. October, 1971. £12.
18. SANDS, W. A. The Soldierless Termites of Africa (Isoptera: Termitidae). Pp. 244: 9 plates, 661 text-figures. July, 1972. £9.90.
19. CROSSKEY, R. W. A Revisionary Classification of the Rutiliini (Diptera: Tachinidae), with keys to the described species. Pp. 167: 109 text-figures. February, 1973. £6.50.
20. VON HAYEK, C. M. F. A Reclassification of the Subfamily Agrypninae (Coleoptera: Elateridae). Pp. 309: 17 text figures. October, 1973. £12.30.
21. CROSSKEY, R. W. A Conspectus of the Tachinidae (Diptera) of Australia, including keys to the supraspecific taxa and taxonomic and host catalogues. Pp. 221: 95 text-figures. December, 1973. £9.55.

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A REVISION OF THE FAMILIES SYNNEURIDAE AND CANTHYLOSCELIDAE (DIPTERA)

A. M. HUTSON

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ENTOMOLOGY Vol. 35 No. 3
LONDON : 1977

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BY

ANTHONY MICHAEL HUTSON

Pp. 65–100; 26 *Text-figures*

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By A. M. HUTSON

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SYNOPSIS

The families Synneuridae and Canthyloscelidae (in recent years combined under the single name Hyperoscelidae) are revised. A new genus and species, *Exiliscelis californiensis*, is described from North America and assigned to the Synneuridae. *Synneuron decipiens* and *Canthyloscelis balaena* are new species described from North America and New Zealand respectively. New synonymy is proposed in the genera *Hyperoscelis* and *Canthyloscelis*. Twelve species are recognized in the families and keys are provided for the identification of all known species. The phylogeny of the group and its relationships with Scatopsidae are discussed and a systematic analysis is presented to show these relationships. This is related to the existing knowledge of the immature stages.

INTRODUCTION

In preparing the description of a new genus and species to be included in the family Hyperoscelidae it was apparent that although the group has been the subject of what might be regarded as an inordinate amount of attention in recent years, especially in view of the few species contained in it, there was the need for a further review, including a change in the family name. The reasons for this review are that (a) the new genus required the recharacterization of the classification of the group; (b) a number of previous identifications were incorrect and had confused the distribution patterns of species; (c) these misidentifications resulted in synonymy in *Hyperoscelis* and *Canthyloscelis* and in the description of new species in *Synneuron* and *Canthyloscelis*; (d) some further comment on the affinities of the group was appropriate. This revision is thus a compilation of the data published under the family name Hyperoscelidae, with additional data that have become available through the examination of material from almost every known record of the group, in the light of the discovery of a new genus in North America. This small widespread group of flies presents interesting material for the study of phylogeny and zoogeography.

MATERIAL

Specimens of *Canthyloscelis* are well represented in the British Museum (Natural History) (BMNH); extra material of this and material of other genera has been examined by gifts and loans from the following.

CNC, Ottawa	Canadian National Collection, Ottawa, Canada (Dr B. V. Peterson)
DEFW, St Paul	Department of Entomology, Fisheries and Wildlife, University of Minnesota, St Paul, Minnesota, U.S.A. (Dr E. F. Cook)
IAEME, Moscow	Institute of Animal Evolutionary Morphology and Ecology, Moscow, U.S.S.R. (Dr B. M. Mamaev)
IRSNB, Brussels	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (the late Dr J. Verbeke)
KUF, Fukuoka	Kyushu University, Fukuoka, Japan (Dr H. Shima)
J. Martinovsky	Kosmonautu, Olomouc, Czechoslovakia (private collection)
NM, Vienna	Naturhistorisches Museum, Vienna, Austria (Dr R. Lichtenberg)
NR, Stockholm	Naturhistoriska Riksmuseet, Stockholm, Sweden (Dr P. I. Persson)
USNM, Washington	U.S. National Museum, Washington, D.C., U.S.A. (Dr R. Gagné)
ZMU, Helsinki	Zoological Museum of the University, Helsinki, Finland (Dr B. Lindeberg)

HISTORICAL REVIEW

The three genera *Corynoscelis* (= *Hyperoscelis*), *Synneuron* and *Canthyloscelis* were all described as related to *Scatopse*, and Edwards (*in* Tonnoir, 1927*b*) brought them together as the subfamily Corynoscelinae, although he had reservations about including them in the Scatopsidae. Enderlein (1912) gave *Corynoscelis* subfamily rank in the Scatopsidae and later (1936) considered each of *Corynoscelis*, *Synneuron* and *Ectaetia* Enderlein as subfamilies of the new family Corynoscelidae. He did not mention *Canthyloscelis*, but he may have considered this New Zealand genus

outside the scope of his work. Rodendorf (1938), in discussing some Mesozoic Diptera, similarly referred to the Corynoscelidae and later (1951; translated into German, 1958–59), in discussing the locomotory organs of Diptera, separated the Synneuronidae and Canthyloscelididae (which included '*Corynoscelis*'). Hennig, in such papers as his discussion on wing venation in Diptera (1954) and in his use of this group to demonstrate potential origins of Australasian/South American faunal relationships (1960), referred to the Corynoscelidae, but in this latter discussion he was inclined to ignore *Synneuron* as possibly not belonging to the same family. Tollet (1959), although apparently aware of Enderlein's work, but possibly not aware of the other work, described Corynoscelidae as a supposedly new family with two supposedly new subfamilies: Synneurinae and Corynoscelinae. *Canthyloscelis* was included in the Corynoscelinae, but he did not discuss *Ectaetia*. Hardy & Nagatomi (1960), having been informed of the homonymy of *Corynoscelis* Boheman, 1858 with *Corynoscelis* Burmeister, 1847, renamed the genus *Hyperoscelis* and hence the family Hyperoscelidae. Cook (1963) did not separate the family into subfamilies. Rodendorf (1964; translated into English, 1974) split the group into two families Synneurontidae and Hyperoscelididae. The translation into English of Hennig's (1960) paper (1965) referred to Hyperoscelidae. Mamaev & Krivosheina (e.g. 1969) referred to the Synneurontinae and Hyperoscelidinae. Thus there is a lot of difference of opinion about the higher classification of the group, that of the majority being that the three genera be combined into a single family, with *Synneuron* as a separate subfamily from the other two genera. It should be noted that *Ectaetia* is considered to belong in the Scatopsidae and is outside the scope of the present work.

It will also be obvious from the above that authors have been confused about the 'correct' family-group name endings required for these genera: *Corynoscelis*, *Canthyloscelis* and *Hyperoscelis* have given rise to the family-group endings -scelidae, and -scelididae, while *Synneuron* has given rise to Synneuridae, Synneuronidae and Synneurontidae. Steyskal (1972) has gone to some lengths to discuss the question of *-scelis*-like endings, and my impression from this is that *Canthyloscelis*, etc., should produce the family name Canthyloscelidae (like his example *Glyptoscelis*). This whole question is remote from science and is beyond the knowledge of an ever increasing proportion of zoologists. In nearly all generic names in Zoology, the grammatically correct family-group name is formed in one of two ways: (a) if the name ends in a vowel, this is replaced by *idae*; (b) if the name ends in a consonant, then this and its preceding vowel are replaced by *idae*. I have applied this system to the names *Synneuron* and *Canthyloscelis* to give the family names Synneuridae and Canthyloscelidae, at least one of which I believe to be grammatically correct.

A fourth genus is now available for a single species from California and Oregon in the United States of America. This genus is described below with notes and keys to the species of the other genera, a discussion on the relationships within the four genera and with related families, followed by a world checklist.

From my investigations of the morphology and in an attempt to maintain some stability whilst observing the rules of the *International Code of Zoological Nomenclature*, I am regarding the group as consisting of two families which are

closely related to the Scatopsidae. However, it must be admitted that features of the early stages do not support this division (see p. 95).

In the adults the three families Scatopsidae, Synneuridae and Canthyloscelidae collectively differ from other families of Nematocera by the following combination of characters.

Holoptic (or almost so). Eyes hairy. Ocelli present. Proboscis large with obvious labellae. Mesonotal phragma well developed and invading abdomen. Wings with vein *Sc* absent or ending free, R_1 not extending far beyond middle of wing (usually shorter), R_{2+3} absent, no discal cell, single anal vein present or absent. At most seven unmodified pregenital segments in both sexes. Laterites present on each abdominal segment between tergite and sternite. Males with well developed sperm pump either closely attached to genital complex or (Scatopsinae) lying free in abdomen and connecting via an elongate ejaculatory duct. External genitalia compact, without complex clasping apparatus.

These three families can be separated by the following key.

DIAGNOSTIC KEY TO THE FAMILIES SCATOPSIDAE, SYNNEURIDAE AND CANTHYLOSCELIDAE

1 Median ocellus usually well-developed. Palpi 1-segmented. Antennae 7- to 12-segmented. Wings short and broad with well developed anal lobe. Posterior wing veins weak. Costa ending at R_5. Vein R_4 absent. Vein *r-m* absent (an analogous vein sometimes present). Vein *m-cu* absent. Anal vein present or absent. Anterior spiracle on or partly or entirely separated from anepisternite. Hind femur slender. Small, stout, black or black and yellow species **SCATOPSIDAE**

– Median ocellus small or absent. Palpi 4-segmented. Antennae 12- or 16-segmented. Wings long and narrow without anal lobe. Posterior wing veins strongly developed, often well pigmented. Costa extending beyond R_5. Vein R_4 present or R_1 and R_{4+5} fused. Vein *r-m* represented by a fusion. Vein *m-cu* present or represented by a fusion 2

2 Anal vein absent or present as a weak basal stump. Anterior spiracle at least partly separated from anepisternite. Hind femur slender. Small (wing-length: 2.5–5.0 mm), slender, black species . . . . . **SYNNEURIDAE** (p. 70)

– Anal vein present. Anterior spiracle quite distinctly on anepisternite. Hind femur club-shaped. Larger (wing-length: 4.5–9.0 mm), robust, variegated species **CANTHYLOSCELIDAE** (p. 77)

SYNNEURIDAE Enderlein

Synneurinae Enderlein, 1936 : 56. Type-genus: *Synneuron* Lundström, 1910.
Synneuronidae Enderlein; Rodendorf, 1951 : 64.
Synneurinae Enderlein; Tollet, 1959 : 144.
Synneurontidae Enderlein; Rodendorf, 1964 : 16.
Synneurontinae Enderlein; Mamaev & Krivosheina, 1969 : 933.
Synneurinae Enderlein; Martinovsky, 1972 : 353.

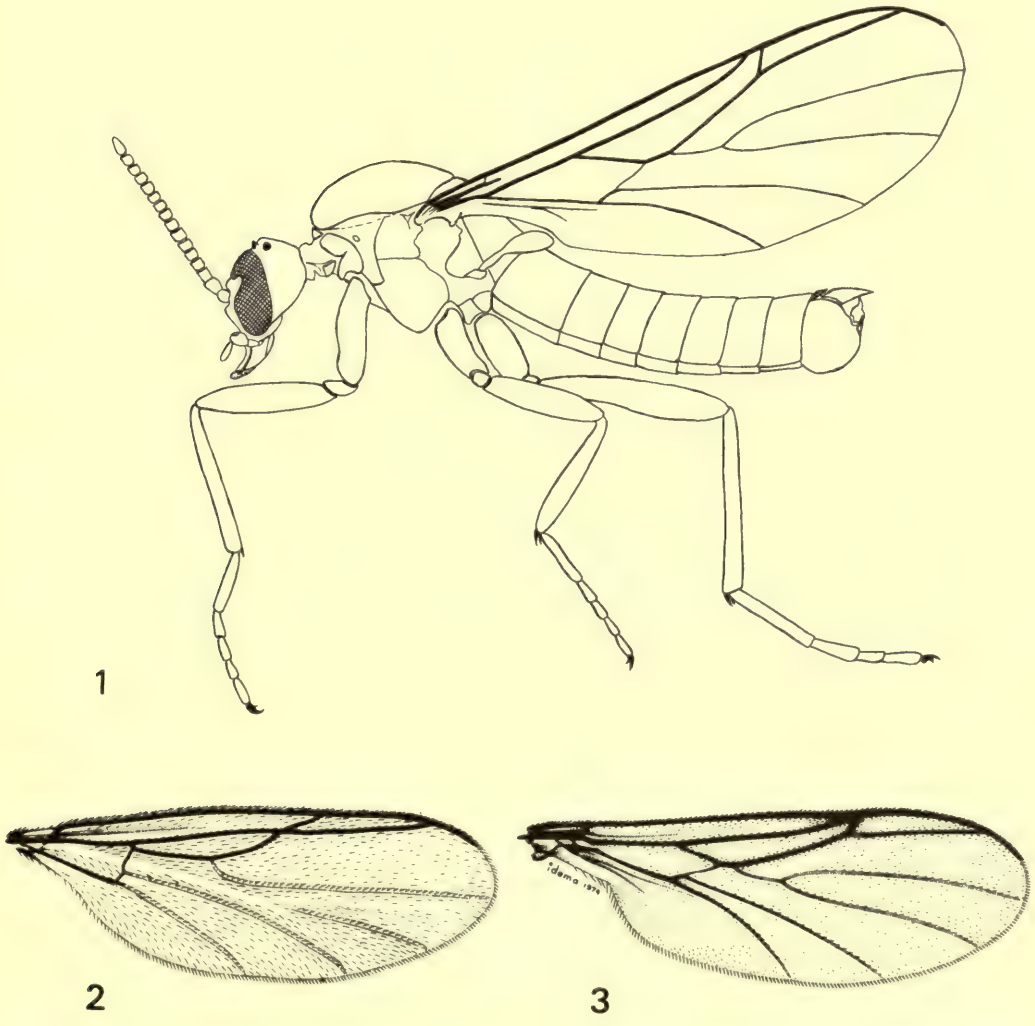
DIAGNOSIS. See above key.

DISTRIBUTION. Holarctic.

Key to genera

1 Anal vein present as faint trace at base. Antennae 16-segmented. Wing with *Rs* free from R_1, vein R_4 present and ending in costa. Median fork complete. ♂ genitalia with prominent claspers. Ovipositor 2-segmented. (Nearctic)
EXILISCELIS (p. 75)

– Anal vein absent. Antennae 12-segmented. Wing with R_{4+5} fused with R_1 for short distance. Vein R_4 absent. Median fork with vein M_2 interrupted at base. ♂ genitalia without prominent claspers. Ovipositor 1-segmented. (Holarctic)
SYNNEURON (p. 72)



Figs 1–3. 1, *Exiliscelis californiensis*, ♂. 2, *Synneuron decipiens*, wing. 3, *Exiliscelis californiensis*, wing. (Figs 2 & 3 by kind permission of the artist, R. Idema, 1974.)

SYNNEURON Lundström

(Text-figs 2, 9–12)

Synneuron Lundström, 1910 : 5. Type-species: *Synneuron annulipes* Lundström, 1910, by monotypy.

Diagnosis. 3 ocelli, median one quite large. Antennae short, 12-segmented, the segments closely applied to each other. Palpi 4-segmented, last three segments short and round. Gena narrow, bottom of eyes very close to mouth margin. Proboscis prominent. Eyes broadly in contact above antennae, narrowly separated below. Meron reduced. Anterior spiracle not on main body of anepisternite. Fore tibia with single minute spur, other tibiae with a pair of minute spurs. Tarsal claws simple. Empodium small and narrow but with a fringe of long hairs. Hind femur not particularly swollen. Hind tibiae straight. Base of tibia and tarsal segments 1–4 usually whitened. Wings (Text-fig. 2) with posterior veins well developed but unpigmented. R_1 and *Rs* fused for a short distance before either reaches costa. Vein *r-m* represented by a long fusion. M_2 interrupted at base. Cu_2 absent. Anal vein absent. Male abdomen with seven unmodified pregenital segments. Sperm pump relatively simple. Female abdomen with seven unmodified pregenital segments, ovipositor 1-segmented, single spermatheca.

Discussion. *Synneuron* was known from the original single specimen from Finland and a second specimen (Duda, 1929; Frey, 1930) from this same country until Cook (1963) recorded several specimens from North America as the same species. Mamaev & Krivosheina (1969) were able to distinguish two species from adults bred from three samples of larvae found in rotting wood of birch, spruce and aspen. The material I have seen from North America is not *annulipes*. I have not seen specimens of *silvestre* Mamaev & Krivosheina, but believe it likely that the Nearctic material is not this species: although I do not find the venational characters given in the key by Mamaev & Krivosheina (1969) satisfactory (they do not even agree with their figures), *silvestre* is stated to be twice as large as *annulipes*, while the Nearctic material is the same size, and the description of the genitalia of *silvestre* does not seem to agree. I am therefore considering the Nearctic material as a new species.

Key to species of *Synneuron*

(*Note*. I have not been able to include *silvestre* in a key to species (see p. 74), so the following key is to distinguish only *annulipes* and *decipiens*.

The character of the leg colour is not very reliable and is only meant to imply that there is a greater tendency for North American specimens to have entirely dark legs and a greater tendency for Palaearctic specimens to have part of the tibia and tarsi distinctly white.)

1 Base of tibia and first four tarsal segments usually distinctly white (see note above). ♂ apodemes broadly bilobed basally and without prominent lateral apical lobes. Median process of apodeme broad and tongue-like, broadest toward tip. Gonocoxites small (Text-fig. 9) (Palaearctic) . . . . . ***annulipes*** (p. 73)

– Base of tibia and first four tarsal segments usually somewhat whitened. ♂ apodemes rather rectangular basally with prominent apical lateral lobes. Median process of apodemes narrowing toward tip. Gonocoxite long, reaching beyond tergite 8 and with a reflexed apical lobe (Text-fig. 10) (Nearctic) . . ***decipiens*** (p. 73)

Synneuron annulipes Lundström

(Text-figs 9, 11)

Synneuron annulipes Lundström, 1910 : 6. Holotype ♀, FINLAND: Tuovilanlaks, 4.vii.1865 (*C. Lundström*) (ZMU, Helsinki) [examined].

DIAGNOSIS. As for genus. Genitalia as in Text-figs 9, 11. In the male the apodemes are bilobed basally and without prominent lateral apical lobes. Median process of apodeme broad and tongue-like, broadest towards the tip. Gonocoxites small. ♀ (only one specimen dissected) with tergite 8 more pronounced, sternite 8 less rounded laterally, cerci small. Spermatheca ovoid.

MATERIAL EXAMINED

Holotype ♀, FINLAND (details in synonymy).

FINLAND: Malla (*R. Frey*), 1 ♂ (ZMU, Helsinki); Utsjoki, Li., 18.viii.1948 (*E. Thuneberg*), 1 ♂ (ZMU, Helsinki); Kantalaks, Hellen, 1 ♀ (ZMU, Helsinki).

DISCUSSION. The only other specimens known so far are those reared from light-coloured mould under the bark of an aspen log in the Solnechnogorsk District, Moscow Region, U.S.S.R., by Mamaev & Krivosheina (1969). In the same paper they refer to further specimens, which may be this species, from a spruce stump in the Rybinsk District, Yaroslavl Province.

DISTRIBUTION. Finland, U.S.S.R. (Moscow Region).

Synneuron decipiens sp. n.

(Text-figs 2, 10, 12)

DIAGNOSIS. Wing (Text-fig. 2) 2·5–3·5 mm long. As *annulipes*, but differing in the structure of the genitalia. In the ♂ (Text-fig. 10) the apodemes are rather rectangular basally with prominent apical lateral lobes. The median process of the apodeme narrows toward its tip. The gonocoxites are long, reaching beyond the bilobed tergite 8 and with a reflexed apical lobe. ♀ (Text-fig. 12) with tergite 8 square-ended, sternite eight more evenly rounded laterally, cerci large and prominent. Spermatheca rounded.

MATERIAL EXAMINED.

Holotype ♂, CANADA: Quebec, Laniel, Cage 4, 15.vii.1934 (CNC, Ottawa).

Paratypes. CANADA: Quebec, Laniel, Cage 4, 29.vi.1934, 1 ♀ (BMNH); Quebec, Laniel, Cage 76, 1.viii.1934, 1 ♀ (CNC, Ottawa); Yukon Territory, North Fork Crossing, Mi 43, Peel Plt. Rd, 3500′, 3.vii.1962 (*R. E. Leech*), 1 ♀ (CNC, Ottawa); British Columbia, Summit Lake, Mi 392, Alaska Hwy, 4500′, 2–4.vii.1959 (*R. E. Leech*), 1 ♂ (CNC, Ottawa); Alberta, Johnston Canyon, Banff, 4700′, 18.vii.1962 (*W. R. M. Mason*), 1 ♂ (BMNH); Saskatchewan, St. Victor, 49° 20′ N 105° 54′ W, 27.vi.1955 (*J. R. Vockeroth*), 1 ♂ (CNC, Ottawa); U.S.A.: Alaska, Matanuska, 7.vi.1945 (*J. C. Chamberlin*), 1 ♀ (CNC, Ottawa); Washington, Mt Rainier, Eagle Park, 19.vii.1922 (*A. L. Melander*), 1 ♂ (DEFW, St Paul); Colorado, Nederland, 300′, 5.vii.1961 (*J. G. Chillcott*), 1 ♂ (CNC, Ottawa).

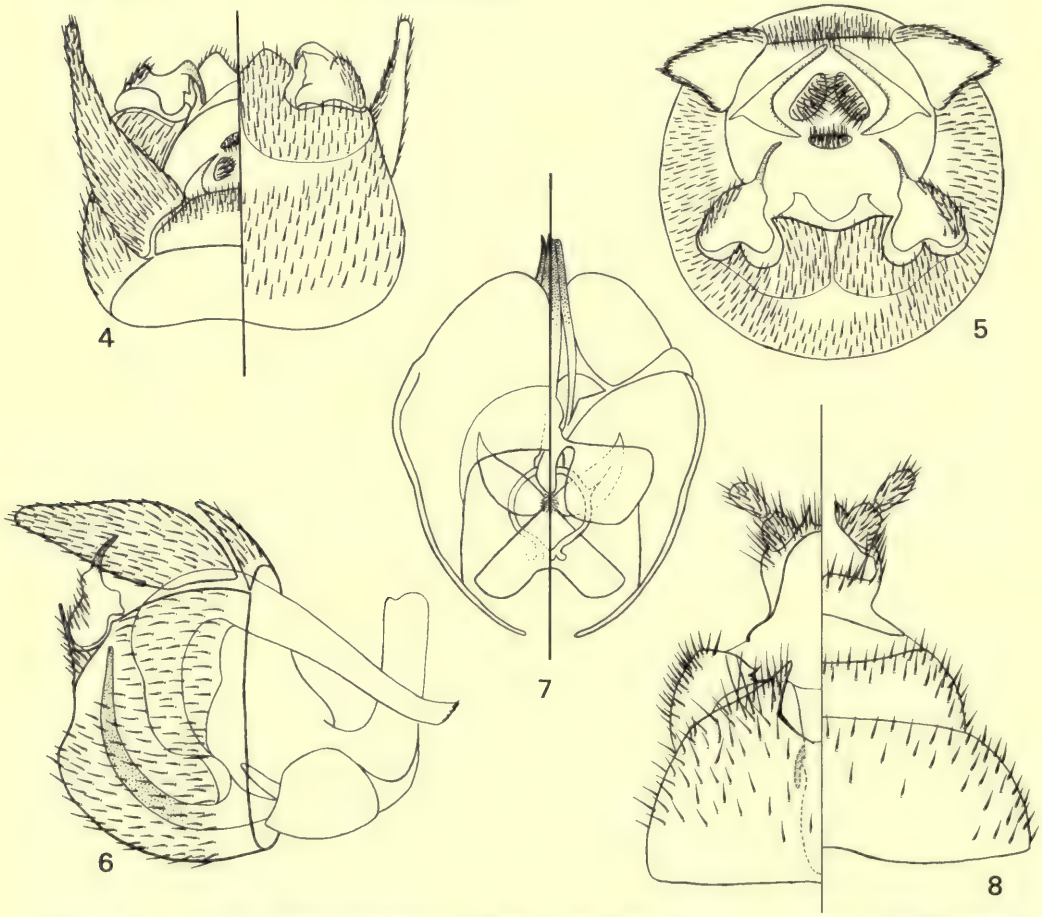
DISTRIBUTION. Northern North America.

Synneuron silvestre Mamaev & Krivosheina

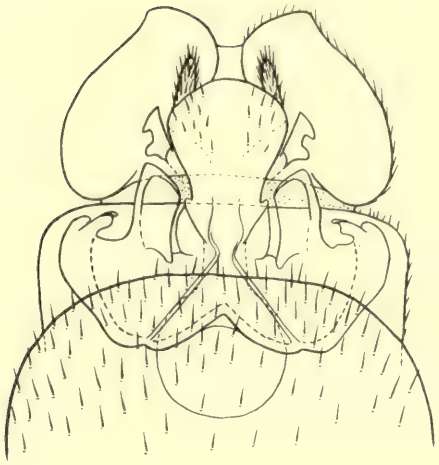
Synneuron silvestre Mamaev & Krivosheina, 1969 : 938. Holotype ♂, U.S.S.R.: Tula Province, Tula abatis, wood of rotten Birch, 5.v.1958 (*B. M. Mamaev*) (IAEME, Moscow) [not examined].

Discussion. The type-series consisted of the holotype and 3 ♂ and 12 ♀ paratypes with the same data. No other specimens of this species are known. The species was not examined in the present study, but is stated to be twice as large as *annulipes* and to exhibit differences in wing venation. The details given in the original description and key need some amplification before the species can be properly recognized. Mamaev (*in litt.*, 1975) says that he could not see any differences in the genitalia and that the main differences were in the larvae.

Distribution. U.S.S.R. (Tula Region).



Figs 4–8. *Exiliscelis californiensis*. 4, ♂ genitalia, dorsal (left) and ventral (right) views; 5, ♂ genitalia, posterior view; 6, ♂ genitalia, lateral view showing sperm pump; 7, ♂ sperm pump, dorsal (left) and ventral (right) views; 8, ♀ ovipositor, ventral (left) and dorsal (right) views.



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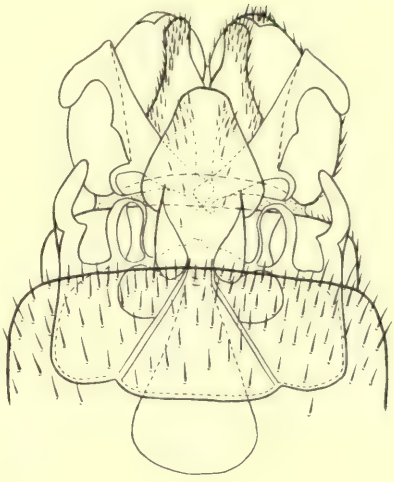

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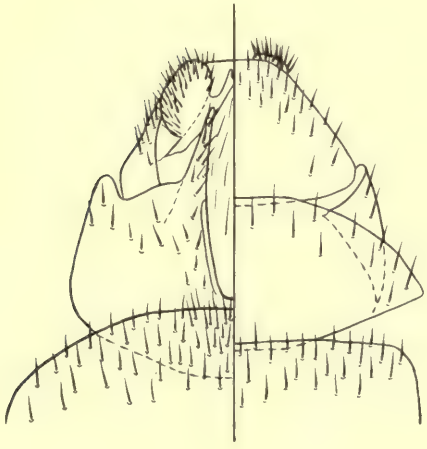

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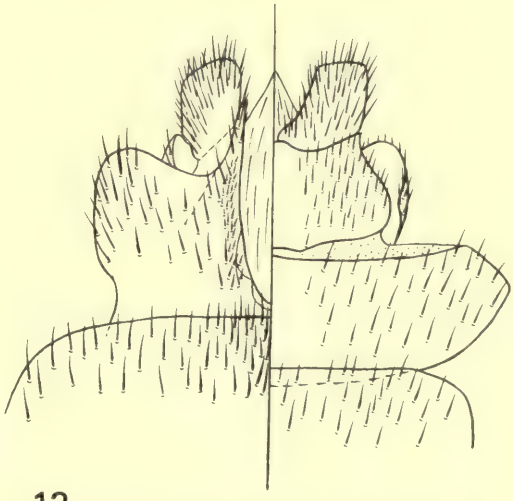

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FIGS 9–12. *Synneuron* species. 9, *annulipes*, ♂ genitalia, ventral view; 10, *decipiens*, ♂ genitalia, ventral view; 11, *annulipes*, ♀ ovipositor, ventral (left) and dorsal (right) views; 12, *decipiens*, ♀ ovipositor, ventral (left) and dorsal (right) views.

EXILISCELIS gen. n.

(Text-figs 1, 3–8)

Type-species: *Exiliscelis californiensis* sp. n.

Small black Scatopsid-like flies with long shining wings. Rather ant-like in general appearance. Similar to *Synneuron*, but readily distinguishable by the characters in the above key (Text-fig. 1).

DIAGNOSIS. Head longer than broad. Eyes separated by one facet width above antennae, approaching each other, but well separated below antennae. Three ocelli. Antennae 16-segmented, all segments closely applied to each other, without necks, and covered with dense short setae. Palpi 4-segmented, basal two segments short and squat, segment three enlarged and bearing a large sensory pit, segment four long and narrow.

Thorax somewhat compressed laterally. Pronotum reduced but forming a complete collar. Propleuron small. Anterior spiracle in front of anepisternite. Sternopleuron well developed. Meron much reduced so that mid and hind coxae almost touch. All coxae strongly developed. Mid and hind coxae directed posteriorly. Femora long and slender; tibiae long, straight and slender. Fore tibiae with a single small but distinct spur; mid and hind tibiae with two short spurs. Pulvilli absent. Empodium reduced to a small scale with marginal hairs. Tarsal claws with a single prominent basal tooth.

Wing (Text-fig. 3) long and narrow with only a very slight anal lobe and no alula. R_4 present, short and ending in costa shortly after apex of R_1. *Rs* and *M* fused for a distance of about half the basal section of *Rs*. Median fork complete. Basal section of M_{3+4} long and in line with a very short *m-cu*. Anal vein absent or represented by a short, weak, basal spur.

Abdomen with seven unmodified pregenital segments. Abdomen somewhat flattened dorso-ventrally and widened toward posterior. ♂ genitalia (Text-figs 4–7) with sperm-pump closely associated with hypopygium and connecting with the exterior via a heavily sclerotised trifid penis-sheath. ♀ genitalia (Text-fig. 8) with 2-segmented ovipositor and two heavily sclerotized spermathecae anterior to a pair of small sclerotized 'accessory glands'.

DISTRIBUTION. Nearctic

Exiliscelis californiensis sp. n.

(Text-figs 1, 3–8)

DIAGNOSIS. Head about 0·6 mm long, shining black with short sparse hairs. Eyes extending ventrally to the mouth margin, covered with a short pubescence. Ocelli set on slightly raised tubercles, equally spaced, median one about half the size of the laterals. Scape and pedicel about equal in size. Flagellar segment 1 slightly longer than wide, 2–13 distinctly wider than long, 14 about twice as long as wide. Proboscis and palpi beset with hairs of various lengths.

Dorsum of thorax shining black except for slight orange coloration on the humeri of the male; evenly covered with short setae that become longer above the wings, but without distinct supra-alar setae. Pleurae and postnotum somewhat reddish black. Anepisternum strongly developed, but with only a few weak hairs. Sternopleura with weak sparse hairs ventrally. Pleurotergite well developed. Scutellum not very prominent and sparsely covered with weak setae, which are quite long toward the posterior margin. Postnotum about 1·5 times the length of the scutellum, bare of setae. Capitulum of haltere twice as long as pedicel, both without distinct setae, except for about three very short setae at the base of the capitulum.

Mid coxa slightly shorter than hind coxa which is shorter than fore coxa. Tibiae widening slightly and evenly toward the apex, with a comb of pale setae on the posterior side at their apex. Tarsi slender and unmodified, hind basitarsus about twice as long as second tarsal segment.

Wing (Text-fig. 3) 3·0–3·5 mm long, evenly covered on both sides with microtrichia. Basal section of vein M_{3+4} bare, all other veins bearing macrotrichia (only 2 or 3 on petiole of median fork). Veins posterior to *Rs* well developed, but not heavily pigmented. *Sc* very short and ending free, but continued as a fold to beyond the fork of the radius. R_5 about six times length of R_4. Costa ending nearly half way between ends of veins R_5 and M_1. Petiole of median fork (M_{1+2}) about equal to basal section of *Rs*. Vein *m-cu* in line with basal section of M_{3+4} and these two veins combined are about equal to the basal section of *Rs*. A distinct

fold running from near wing base through the centre of the basal section of M_{3+4} and continuing into cell M_2. Cu_2 faintly represented, running parallel with *Cu* to just after the junction with *m-cu*. Marginal hairs around wing are dense from the end of the costa to the remnant anal lobe, very sparse from here to wing base.

Abdomen shining black. Genitalia as described for genus and illustrated in Text-figs 4–7 (♂) and Text-fig. 8 (♀).

MATERIAL EXAMINED.

Holotype ♂ (dry-pinned), U.S.A.: California, Amador Co., Pioneer, 8.v.1961 (*O. W. Richards*) (BMNH).

Paratypes. U.S.A.: same data as holotype, 1 ♂, 1 ♀ (slide mounted).

A further single female is very much larger than the type-series (wing-length 6·0 mm). This specimen also has unequal hind tibial spurs and a much longer head and so may be a second species. Its data are: U.S.A.: Oregon, Humbug Mts, Curry Co., 20.vi.1939 (*T. Aitken*) (B. Brookman coll., in USNM, Washington (per E. F. Cook)).

CANTHYLOSCELIDAE Rodendorf

Corynoscelinae Enderlein, 1912 : 264. Type-genus: *Corynoscelis* Boheman, 1858 [junior homonym of *Corynoscelis* Burmeister, 1847].
Corynoscelidae Enderlein; Enderlein, 1936 : 56.
Canthyloscelididae Rodendorf, 1951 : 64. Type-genus: *Canthyloscelis* Edwards, 1922.
Corynoscelinae [Enderlein]; Tollet, 1959 : 144. [Proposed as new subfamily.]
Hyperoscelidae Hardy & Nagatomi, 1960 : 263. Type-genus: *Hyperoscelis* Hardy & Nagatomi [replacement name for *Corynoscelis* Boheman]. **Syn. n.**
Hyperoscelididae Hardy & Nagatomi; Rodendorf, 1964 : 16.

NOMENCLATURE. The *International Code of Zoological Nomenclature* (1964), Article 23d(i), states that the oldest valid family-group name must be used. The homonymy of *Corynoscelis* Boheman makes the family name based on it invalid (Article 39). If the two families considered in this paper are regarded as one composite family, the valid family-group name would be Synneuridae Enderlein, 1936, as this name has priority. Where they are regarded as two separate families, as in the present work, the name Canthyloscelidae, proposed as Canthyloscelididae by Rodendorf (1951), predates Hyperoscelidae Hardy & Nagatomi (1960), and so is the valid name for the restricted family including *Hyperoscelis* and *Canthyloscelis*. Thus the family name Hyperoscelidae must be changed: for Canthyloscelidae if the family is restricted to *Canthyloscelis* and *Hyperoscelis*, or Synneuridae if *Synneuron* and *Exiliscelis* are included.

I regard it as both unnecessary and undesirable to change the family-group name yet again for a group that, though small, has already been widely discussed outside the realm of basic taxonomy: in fields such as the evolution of Diptera (Rodendorf, 1964; Mamaev, 1968), zoogeography (Hennig, 1960; 1965), anatomy, ecology, physiology and development (Rodendorf, 1951; Hennig, 1954; Krivosheina & Mamaev, 1967; Mamaev & Semenova, 1969; Krivosheina, 1969), as well as important general faunal lists (e.g. Cook, 1965; 1967; Martinovsky, 1972) and key

works (e.g. Seguy, 1951; Brues, Melander & Carpenter, 1954; Bei-Bienko, 1969; Colless & McAlpine, 1970; Hennig, 1973). It is to be hoped that this latest change 'in the interests of stability' is the last of such changes.

DIAGNOSIS. As in key to families (p. 70).

DISTRIBUTION. South America, New Zealand and Palaearctic.

KEY TO THE GENERA

1 Median fork complete. Claws simple. Antennae only about two-thirds length of thorax. (Palaearctic) . . . . . ***HYPEROSCELIS*** (p. 78)

– Median fork with M_2 interrupted at base. Claws with a comb-like or toothed basal enlargement. Antennae as long as head and thorax together. (Neotropical and New Zealand). . . . . ***CANTHYLOSCELIS*** (p. 83)

HYPEROSCELIS Hardy & Nagatomi

(Text-figs 13–19)

Corynoscelis Boheman, 1858 : 56. Type-species: *Corynoscelis eximia* Boheman, 1858, by monotypy. [Preoccupied by *Corynoscelis* Burmeister, 1847.]

Spiloptera Zetterstedt, 1860 : 6487. Type-species: *Spiloptera arctica* Zetterstedt, 1860, by monotypy. [Proposed in synonymy in footnote.]

? *Eucorynoscelis* Rodendorf, 1951 : 65. Type-species: *Corynoscelis eximia* Boheman, 1858, by monotypy.

Hyperoscelis Hardy & Nagatomi, 1960 : 264. [Replacement name for *Corynoscelis* Boheman.]

NOMENCLATURE. Zetterstedt's footnote (1860) stating that he had prepared a description of *Corynoscelis* under the name *Spiloptera* produces a problem of nomenclature. Jerdon (1862) applied the name *Spiloptera* to a genus of birds and Oates (1889), considering *Spiloptera* Jerdon a junior homonym of *Spiloptera* Zetterstedt, proposed the name *Elachura* as a replacement name. *Elachura* is currently regarded as a junior synonym of *Spelaeornis* David & Oustalet, 1877 (Peters, 1964). Hardy & Nagatomi (1960), realising the homonymy of *Corynoscelis* Boheman and *Corynoscelis* Burmeister, proposed the replacement name *Hyperoscelis* for Boheman's genus. At that time their action was perfectly correct, but since then the *International Code of Zoological Nomenclature* (ICZN, 1964) has been altered so that Article 11d now states that a name proposed in synonymy is to be regarded as available if it has been used as a primary homonym. Such is the case with *Spiloptera* Zetterstedt, which is therefore the oldest available name for this genus. However, since *Spiloptera* Zetterstedt has never been referred to in entomological literature since 1860, I am regarding it as a *nomen oblitum* and intend to apply to the International Commission on Zoological Nomenclature to ratify this.

The name *Eucorynoscelis* also predates *Hyperoscelis*, but I am not certain of its validity. It appears in the legend of a figure in Rodendorf (1951) in the combination *Eucorynoscelis eximia* Boheman. It is not mentioned in the text.

I have not found the name anywhere else. If this is its only mention then it is an obvious synonym of *Corynoscelis* and *Hyperoscelis* (same type-species by monotypy), but since it may be described elsewhere (it is included in his family Canthyloscelidae), I have applied it to this genus with reservations.

DIAGNOSIS. Three ocelli present, median one reduced. Antennae 16-segmented, loosely jointed. Eyes narrowly separated above and below antennae. Gena small, mouth margin very close to bottom of eyes. First segment of palpi very small, second rounded, third and fourth elongate. Minute single spurs on fore and mid tibiae. Tarsal claws simple. Empodium broadly rounded and fringed with hairs. Hind femur swollen. Hind tibia slender and curved to fit femur. Fore and mid legs yellow, hind legs variegated. Wings with posterior veins well pigmented. A short vein R_4 present and usually ending in costa, otherwise incomplete and ending free. Vein *r-m* represented by a long fusion. Median fork complete. Cu_2 very weakly present. Anal vein reaching margin, but weak towards wing base. Basal abscissa of M_{3+4} in line with short *m-cu*. Seven unmodified pregenital segments. ♂ with tergite 8 almost atrophied. ♀ with 2-segmented ovipositor and one simple spermatheca.

DISTRIBUTION. Palaearctic.

DISCUSSION. Boheman (1858) first described *Corynoscelis eximia* from material sent by Holmgren from Swedish Lapland. In the same year Loew (1858) described and figured the same specimen(s). Presumably because he knew that Boheman was describing it, Loew did not give it a name. Zetterstedt (1860) described it using Boheman's name, but in a footnote stated that he too had already seen Holmgren's specimen and had prepared his description of it under the name *Spiloptera arctica*. Mik (1886), still discussing the same material, though probably not from first hand experience, noted its superficial similarity to certain Empidid genera (*Oedalea* and *Hybos*) and confirmed this similarity to the latter genus when he (Mik, 1900) obtained a specimen from Rumania which he considered to be the same species (but see p. 83). Lundström (1910) described what he thought was the female of *eximia*, but the sex and identity of these specimens are in doubt (see p. 82).

Dahl (1911) described a larviform female insect as the female of *Corynoscelis*. The specimen had been found on an empty lepidopterous pupa and, assuming it to be parasitic, Dahl discussed its relationship with fleas, etc., as well as Scatopsidae and Phoridae. Bergroth (1912) was quick to point out Lundström's (1910) description attributed to the female of *eximia* as a normally full-winged fly, but agreed with Dahl that his specimen belonged near *Corynoscelis* and *Scatopse* in the Bibionidae. Enderlein (1912), without seeing the specimen himself, considered Dahl's specimen as more Mycetophilid-like and erected a new genus and species for it, *Dahlica larviformis*. In 1936 Enderlein put it in a separate subfamily of Mycetophilidae. There it remained until Bartošová & Dušková (1958) described a second species, *Dahlica hirta*, from Czechoslovakia. Their good description and figures enabled Stýs (1960) to re-examine the affinities of *Dahlica* and he realized that both species were moths and probably Psychidae. *Dahlica larviformis* Enderlein is now regarded as a synonym of *Solenobia triquetrella* (Hübner, 1812) (Lepidoptera: Psychidae) (vide Dierl, 1968).

Meanwhile, Frey (1916) had recorded another specimen from Finland, after

which no further specimens of the genus are known to me until Hardy & Nagatomi (1960) described a second species, *insignis*, from a single male from Japan. Mamaev & Krivosheina (1969) reared large numbers of *Hyperoscelis* of two species from larvae found in rotting wood. By examining type-material of *eximia* they were correctly able to decide which species was undescribed. The undescribed species, *veternosa*, was described from 21 males and the sexes of the material of *eximia* were not noted, so it was not until Martinovsky (1972) that a true female *Hyperoscelis* was adequately described. This is the most recent published record of *Hyperoscelis* known to me.

Of the three described species I can only recognise two as valid, and these are separable by the following key.

Key to species of *Hyperoscelis*

1 Length of R_5 equal to distance between the base of M_{1+2} and the fork of R_{4+5}. Basal part of M not parallel with R_1, unsclerotized, without macrotrichia; macrotrichia absent between these two veins. Tergite 8 of male with lateral processes and a deep median emargination, claspers as Text-fig. 17, sternite 9 with marked lateral extensions (Text-figs 13, 15–17).
Female ovipositor as Text-fig. 19 ***eximia*** Boheman (p. 80)

– R_5 shorter than distance between base of M_{1+2} and the fork of R_{4+5}. Basal part of M before the *r-m* fusion parallel with R_1, heavily sclerotized and covered with macrotrichia; macrotrichia present on wing membrane between these two veins. Tergite 8 of male smoothly rounded with a shallow median emargination, claspers as Text-fig. 18, sternite 9 without marked lateral extensions (Text-fig. 14).
veternosa Mamaev & Krivosheina (p. 83)

Hyperoscelis eximia (Boheman)

(Text-figs 13, 15–17, 19)

Corynoscelis eximia Boheman, 1858 : 56. Syntypes 2 ♂, 1 ♀, Sweden: Tarna [65°43′ N, 15°17′ E], Laxfjellet, 15–18.vii. (*A. E. Holmgren*) (NR, Stockholm) [examined].

Hyperoscelis insignis Hardy & Nagatomi, 1960 : 265. Holotype ♂, Japan: Hataganaru (Tazima), 26.v.1955 (*E. Fujita*) (KUF, Fukuoka) [examined]. **Syn. n.**

Diagnosis. As in key to species. Some authors (Hardy & Nagatomi, 1960 and Martinovsky, 1972) have overlooked the small first palpal segment and considered the palps 3-segmented. All specimens I have seen have 4-segmented palps.

Material examined.

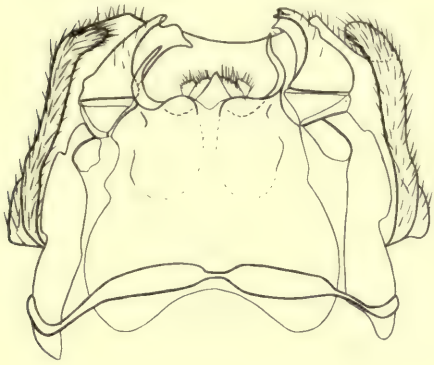
2 ♂, 1 ♀ syntypes of *eximia*, Sweden (details in synonymy). Holotype ♂ of *insignis*, Japan (details in synonymy).

Czechoslovakia: Moravia, Bedrichov bei Rymarov (Bezirk Sumperk), 500 m, 18.vi.1970 (*J. Martinovsky*), 1 ♀ (coll. J. Martinovsky, Olomouc); Moravia, Josefova u Branne, 20.vi.1972 (*J. Martinovsky*), 1 ♀ (BMNH).

Discussion. Boheman's specimens are in good condition. No holotype was originally recorded and no lectotype has been designated since. As there is no

suggestion that the series consists of more than one species, I have not selected a lectotype. The genitalia of one of the males have been cleared and are in a microvial on the pin, and are figured here (Text-figs 13, 15–17).

Mik (1900) recorded a specimen of this species from Rumania, but his specimen proves to be *veternosa* (see under that species).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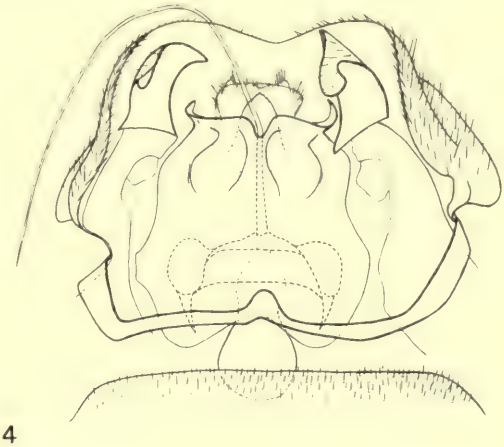
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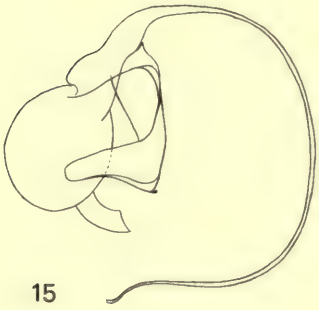
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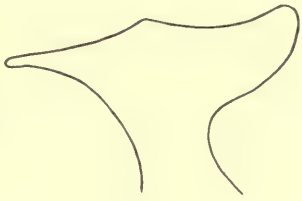
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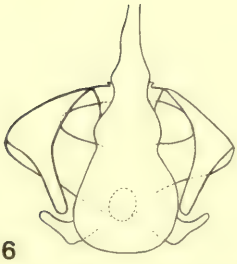
18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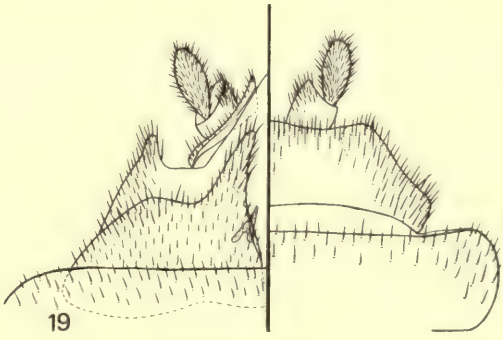

19

FIGS 13–19. *Hyperoscelis* species. 13, *eximia*, ♂ genitalia, ventral view; 14, *veternosa*, ♂ genitalia, ventral view; 15–17, *eximia* showing (15), ♂ sperm pump, lateral view, (16) ♂ sperm pump, ventral view, (17) outline of lateral view of ♂ clasper; 18, *veternosa*, outline of lateral view of ♂ clasper; 19, *eximia*, ♀ ovipositor, ventral (left) and dorsal (right) views.

Lundström (1910) and Frey (1916) recorded three specimens (as ♀) from three localities in Finland. Two of these specimens have been attacked by pest beetle and all that remains are three wing fragments and one antenna. One of the wing fragments shows the base of a strong vein R_4 which, estimated from the position of the medial veins, may be in the relative position of *eximia* rather than *veternosa*. Lundström's two specimens were from Ruovesi [61°59'N, 24°05'E] and Tuovilanlaks [c.63°N, c.28°E]. There is a bare celluloid strip on the pin of the Ruovesi specimen; whatever was mounted on it is lost except for a small piece of tissue which could be eggs. If it is eggs then the specimen must have been female, otherwise there is no way of sexing the original specimen. A separate mount of one antenna is part of this specimen. The Tuovilanlaks specimen is the specimen that Hardy & Nagatomi (1960) used to compare with their specimen from Japan and is a male of *veternosa*, misleading them into describing their specimen as a new species. Of Frey's specimen from Kangasala [61°30'N, 24°00'E] there is no trace on the pin. One, or two, of the wing fragments mentioned above belong to this specimen, but it remains unidentifiable. The Tuovilanlaks specimen and the remains of the other two specimens are in the University Museum, Helsinki, Finland.

Rodendorf (1951), in his discussion on the locomotory organs of Diptera, figures the wing of what he calls *Eucorynoscelis eximia* Boheman from Denmark. The status of the name *Eucorynoscelis* has already been discussed and I know of no specimen of this family from Denmark.

Hardy & Nagatomi (1960) described *H. insignis* from a single ♂. In structural details it does not differ from *eximia*, although there are quite distinct differences in the colour of the thorax and abdomen. In all other specimens of the genus examined in the present study the only yellow visible on these parts was around the anterior spiracle, otherwise the thorax and abdomen are dark reddish brown to black. In the Japanese specimen, most of the pronotum, the area of the anterior spiracle and the scutellum, particularly medially, are all yellow and the dorsum is yellow with three black stripes. The abdomen has yellow spots along the mid-dorsal line and the sternites are completely yellow. Despite these colour differences I have no hesitation in synonymizing *insignis* with *eximia*.

Mamaev & Krivosheina (1969) recorded *eximia* from the Maritime Province on the east coast of the U.S.S.R. Their specimens were bred from various types of rotting forest timber, mainly elm. Other series of larvae that were probably of this species were found in spruce wood much damaged by brown rot. These were from the Moscow and Yaroslavl Regions of the U.S.S.R. This material is in the IAEME, Moscow.

Martinovsky (1972) was the first to adequately describe and figure the female from his first specimen, which was found in a stand of *Rubus idaeus* L. in a mixed wood. His first specimen is in his private collection and he has kindly donated a second specimen to the BMNH.

DISTRIBUTION. Sweden, Czechoslovakia, U.S.S.R. (Maritime Province), Japan. Also probably in Finland and the Yaroslavl and Moscow Regions of U.S.S.R.

Hyperoscelis veternosa Mamaev & Krivosheina

(Text-figs 14, 19)

Hyperoscelis veternosa Mamaev & Krivosheina, 1969 : 936. Holotype ♂, U.S.S.R.: Ukraine, Rakhov, 17.vi.1966 (*B. Mamaev*) (IAEME, Moscow) [not examined].

Diagnosis. As in key to species.

Material examined.

U.S.S.R.: same data as holotype, 2 ♂ (paratypes) (BMNH). Rumania: Bucharest, 1898 (*J. Mik*), 1 ♂ (NM, Vienna). Finland: Tuovilanlaks, 2.vi.1865, 1 ♂ (ZMU, Helsinki).

Discussion. The type-material of 21 males was reared from larvae in spruce wood affected by brown rot.

In recording his specimen from Rumania, Mik (1900) noted that vein R_4 (by current terminology) is rudimentary and does not reach the costa. As this is a feature of *veternosa*, the specimen was re-examined and found to be ♂ *veternosa*.

While the identity of Lundström's Ruovesi specimen and Frey's Kangasala specimen remains in doubt as the specimens are destroyed (see above under *eximia*), Lundström's other specimen, from Tuovilanlaks, was described and figured by Hardy & Nagatomi (1960) as *eximia*. The specimen is mounted on a slide and is a ♂ *veternosa*.

Distribution. Finland, Rumania, U.S.S.R. (Ukraine: Transcarpathian Mts).

CANTHYLOSCELIS Edwards

(Text-figs 20–25)

Canthyloscelis Edwards, 1922 : 268. Type-species: *Canthyloscelis antennata* Edwards, 1922, by original designation.

Diagnosis. Two large lateral ocelli, small median ocellus present (subgenus *Araucoscelis*) or absent (subgenus *Canthyloscelis*). Antennae 16-segmented, simple to distinctly pectinate, at least as long as head and thorax combined. Palpi 4-segmented, long and slender. Tibial comb well developed (*Araucoscelis*) or poorly developed (*Canthyloscelis*). Tarsal claws with a large basal lobe bearing a number of small teeth. Empodium large and fleshy. Hind femur greatly swollen, often with a row of small pegs on the ventral surface. Hind tibia slender and curved to fit tightly against femur. Wings with posterior veins almost as heavily pigmented as anterior veins. A short R_4 present and ending in costa. *r-m* represented by a long fusion. M_2 interrupted at base. Males with only 2 or 4 (*Canthyloscelis*) or 6 (*Araucoscelis*) unmodified pregenital segments. Ovipositor 2-segmented. One spermatheca, strikingly modified in *Canthyloscelis* (Text-fig. 25) or simple in *Araucoscelis*.

Discussion. Edwards (1922) described *Canthyloscelis* for three species in New Zealand. In 1930, he described a second subgenus (*Araucoscelis*) for two species from South America, to which he later (1934) added a third species, also from South America. In describing a fourth South American species, Tollet (1959) separated the South American species into two subgenera on the basis of the pectinate

antennae of the male of one species. A fourth New Zealand species is described here.

The sharp distinctions between the New Zealand and South American species-groups are clear; these could well be regarded as separate genera, but it is convenient to leave them as congeners for the time being, thereby expressing the opinion that they are sister-groups and that together they are the sister-group of *Hyperoscelis* (as proposed by Hennig, 1960). I would also agree with Hennig (op. cit.) that the South American species do not merit separation into two subgenera purely on the basis of whether or not the male antennae are pectinate, a patently derived character. Certainly the South American species do not differ in any fundamental character, and with the species synonymy given here such a division serves no useful purpose.

DISTRIBUTION. New Zealand and South America.

KEY TO SUBGENERA AND SPECIES OF *Canthyloscelis*

1 Median ocellus absent. Eyes narrowly separated above antennae. Flagellar segments with distinct necks. Gena well developed, so lower margin of eyes well separated from mouth margin. Meron well developed. Hind femur swollen in apical two-thirds. Wing vein R_5 not thickened towards tip. Basal abscissa of vein M_{3+4} almost vertical, joining *Cu* before the posterior fork. Two or 4 unmodified pregenital segments in male. Female with single complex spermatheca. (New Zealand). . . . . (Subgenus ***CANTHYLOSCELIS***) 2

– Small median ocellus present. Eyes broadly in contact above antennae. Mouth margin very close to bottom of eyes. Meron somewhat reduced. Hind femur swollen from near base. Wing vein R_5 thickened beyond fork with R_4. Basal abscissa of M_{3+4} almost vertical and in line with short *m-cu*. Six unmodified pregenital segments in male. Female with single simple spermatheca. (South America). . . . . (Subgenus ***ARAUCOSCELIS***) 5

2 Wings with dark mark near apex. Pleurae at least somewhat darkened. Eyes of ♂ almost touching above antennae. ♂ abdomen with only two unmodified pregenital segments. 3

– Wings completely clear. Pleurae uniformly yellowish. ♂ eyes distinctly separated above antennae. ♂ abdomen with four unmodified pregenital segments.
Microtrichia extensive on upper as well as lower surface of wing, covering entire wing except for extreme base. . . . . ***claripennis*** (p. 89)

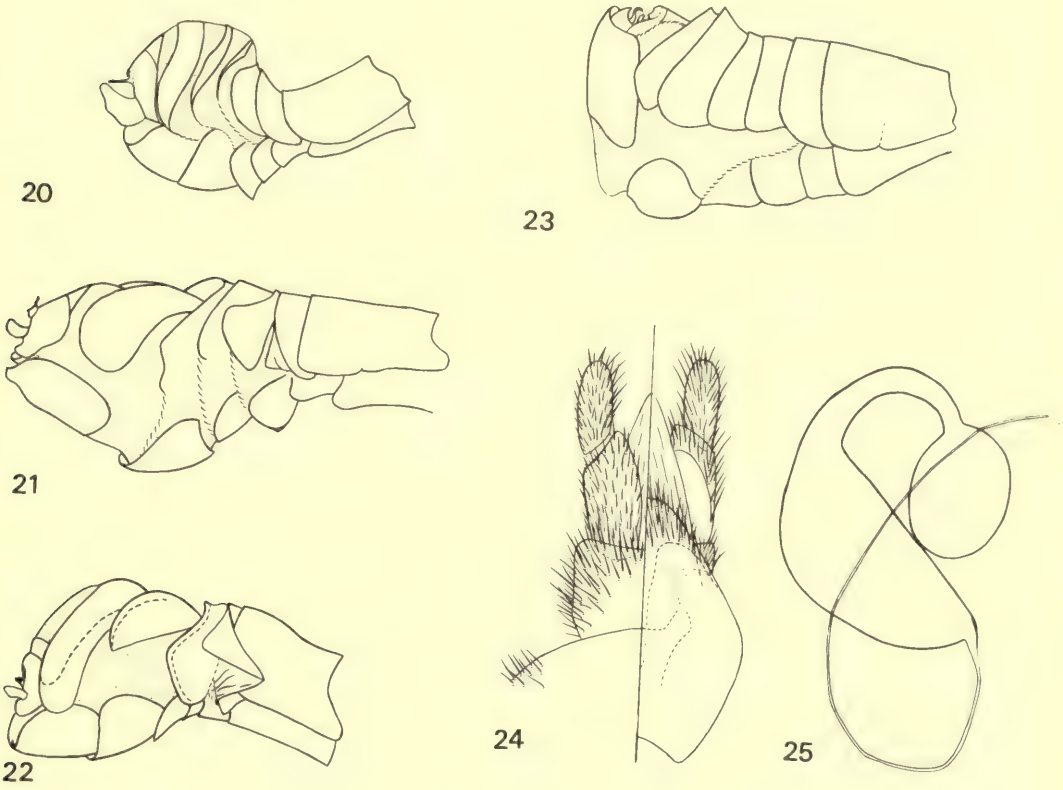
3 All coxae pale yellowish. Hind basitarsus about twice as long as second tarsal segment. 4

– Hind coxae shining black. Hind basitarsus about same length as second tarsal segment.
Thorax uniformly reddish. Wing lacking microtrichia on costal, R_1, basal cells and basal areas of cells R_5 and M_2, and restricted to outer parts in cells R_4, M_{3+4}, *Cu* and anal. Tergite 9 of male simple . . . . . ***nigricoxa*** (p. 88)

4 Thorax with pale ground colour and three more or less distinct stripes. Wing lacking microtrichia on costal, R_1, basal, most of anal cells and extreme bases of other cells. Tergite 9 of male with a pair of long fine points. . . ***antennata*** (p. 87)
Thorax unstriped. Microtrichia widely distributed on both wing surfaces, absent from most of costal, *Cu*, anal and basal cells and extreme bases of cells R_1 and M_2. Tergite 9 of male emarginated. . . . . ***balaena*** (p. 88)

5 Wings unmarked or with only very vague marking at wing tip. Palpi pale. Antennae of ♂ strongly pectinate . . . . . ***pectinata*** (p. 86)

– Wings with distinct marking toward tip and also frequently in costal cell and on hind margin. Palpi dark. Antennae of ♂ at most slightly serrate ***pictipennis*** (p. 86)



FIGS 20–25. *Canthyloscelis* species. 20, ***antennata***, ♂ abdomen, lateral view; 21, ***nigricoxa*** ♂ abdomen, lateral view; 22, ***balaena***, ♂ abdomen, lateral view; 23, ***claripennis***, ♂ abdomen, lateral view; 24, 25, ***antennata*** ♀ showing (24) ovipositor, ventral (left) and dorsal (right) views, (25) spermatheca.

Subgenus ***ARAUCOSCELIS*** Edwards

Araucoscelis Edwards, 1930 : 90 [as subgenus of *Canthyloscelis* Edwards]. Type-species: *Canthyloscelis pectinata* Edwards, 1930, by original designation.

Chiliscelis Tollet, 1959 : 146 [as subgenus of *Canthyloscelis* Edwards]. Type-species: *Canthyloscelis pictipennis* Edwards, 1930, by original designation.

DIAGNOSIS. As in key on p. 84.

DISCUSSION. Hennig (1960) suggested the above synonymy. Cook (1967), in error, has stated *valdiviana* to be the type-species of *Chiliscelis*.

DISTRIBUTION. South America.

Canthyloscelis (Araucoscelis) pectinata Edwards

Canthyloscelis (*Araucoscelis*) *pectinata* Edwards, 1930 : 90. Holotype ♂, ARGENTINA: Terr. Rio Negro, Puerto Blest, L. Nahuel Huapi, 2–3.xii.1926 (*F. & M. Edwards*) (BMNH) [examined].

DIAGNOSIS. Antennae of male with first nine flagellar segments bearing a long ventral basal branch and a slight node at the apex. Flagellar segments with distinct necks. Palpi dark. First hind tarsal segment about twice as long as second. Wings clear or with a very vague subapical cloud, posterior veins rather pale. Head, thorax and abdomen reddish brown with three indistinct thoracic stripes. All coxae and fore and mid legs pale yellow, getting darker towards terminal tarsal segments (femur sometimes darkened above). Hind legs with reddish brown band on apical half and at apex of femur, tibiae and tarsi darkened. Male with sternite 7 greatly enlarged, bowl-shaped, with genitalia directed dorsally. Tergite 9 with a pair of narrow outwardly curved processes. Claspers relatively small and broad, with a longitudinal crest, so that it is T-shaped in cross-section. Another pair of long curved finely pointed processes below this (? dististyle).

MATERIAL EXAMINED.

Holotype ♂, ARGENTINA (details in synonymy).

ARGENTINA: same data as holotype, 10 ♂, 3 ♀; Terr. Rio Negro, L. Correntoso, 18–25.xi.1926 (*F. & M. Edwards*), 3 ♂. CHILE: S., Llanquihue prov., Casa Pangue, 4–10.xii.1926 (*F. & M. Edwards*), 1 ♀. (All paratypes; all in BMNH.)

DISTRIBUTION. Border area of Argentina and S. Chile, near L. Nahuel Huapi.

Canthyloscelis (Araucoscelis) pictipennis Edwards

Canthyloscelis (*Araucoscelis*) *pictipennis* Edwards, 1930 : 92. Holotype ♀, ARGENTINA: Terr. Rio Negro, Lake Frias, 3.xii.1926 (*F. & M. Edwards*) (BMNH) [examined].

Canthyloscelis apicata Edwards, 1934 : 186. 4 syntypes ♂, CHILE: Comudes, 16–17.ii.1902 (*S. Schonemann*) (1 in BMNH) [examined]. **Syn. n.**

Canthyloscelis (*Chiliscelis*) *valdiviana* Tollet, 1959 : 147. Holotype ♂, CHILE: Valdivia prov., nr L. Panguipulli, Shoshnenco, 200 m, 4–6.iii.1955 (*L. E. Peña*) (IRSNB, Brussels) [examined]. **Syn. n.**

DIAGNOSIS. Flagellar segments of male slightly serrate, loosely jointed but without obvious necks. Palps pale yellow. First hind tarsal segment about 1·5 times as long as second. Wings with dark subapical band and slightly darkened costal cell. Posterior veins darkened, as usual. Head (usually), thorax and abdomen dark reddish brown, thorax unstriped. Legs as *pectinata*, except that hind coxae dark in the Casa Pangue ♂. Sternite 7 of male greatly enlarged, bowl-shaped with genitalia directed dorsally. Tergite 9 with pair of broad, straight median processes. Claspers broad, triangular, with small inner lateral processes. The processes below this (? dististyles) short, straight and blunt, slightly bulbous-tipped.

MATERIAL EXAMINED.

Holotype ♀ of *pictipennis*, ARGENTINA: (details in synonymy). 1 ♂ syntype of *apicata*, CHILE (details in synonymy). Holotype ♂ of *valdiviana*, CHILE (details in synonymy).

CHILE: Llanquihue, Casa Pangue, xii. 1926 (*R. & E. Shannon*), 1 ♂ (USNM, Washington); Chiloe Island, Dalcahue, 10–12.ii.1957 (*L. E. Peña*), 1 ♀ (allotype of *valdiviana*) (IRSNB, Brussels).

DISCUSSION. Edwards (1934) recorded a specimen as the male of *pictipennis*, which he had described from a single female. I have examined this specimen and find it the same species as the single male syntype of *apicata* that is in the BMNH. *C. apicata* was described from four male syntypes, the other three are stated to be in the Zoological Museum of Berlin (now the Zoologisches Museum für Naturkunde der Humboldt-Universität) and have not been examined in the present study.

C. valdiviana was described from several males and two females, and the male holotype and female allotype were examined in the present study. I can see no difference at the species level between the holotype of *valdiviana* and the BMNH type of *apicata* and so am confident in synonymising these two species. Thus *apicata*, the male attributed to *pictipennis* by Edwards (1934), and *valdiviana* are all the same species.

The two females I have seen are the type of *pictipennis* and the allotype of *valdiviana*. Slight differences in the structure of the ovipositor are detectable, but are not enough to regard the two as distinct species and colour differences are no more than the variety shown by the males. The locality of the type of *pictipennis*, although actually in Argentina, is closer to the locality of the males described as *valdiviana* and *pictipennis*, than are the females described as *valdiviana*. I therefore regard all these as a single species, i.e. *apicata* and *valdiviana* are synonyms of *pictipennis*.

DISTRIBUTION. Chile and the border of Argentina between 37° and 43°S (I have not been able to trace Comudes, the type-locality of *apicata*).

Subgenus ***CANTHYLOSCELIS*** Edwards

Canthyloscelis Edwards, 1922 : 268.

DIAGNOSIS. As in key on p. 84.

DISCUSSION. Four species are recognized in this subgenus. They could be separated into two species-groups, namely the *antennata*-group (*antennata*, *nigricoxa*, *balaena*) and the *claripennis*-group (*claripennis*), on the characters in the first half of couplet 2 of the key on p. 84.

DISTRIBUTION. New Zealand.

Canthyloscelis* (*Canthyloscelis*) *antennata Edwards

(Text-figs 20, 24–25)

Canthyloscelis antennata Edwards, 1922 : 268. Holotype ♂, NEW ZEALAND: Wainuiomata, in forest, 14.xii.1920 (*G. V. Hudson*) (BMNH) [examined].

DIAGNOSIS. Eyes of male almost touching above antennae. Dorsum of thorax with pale ground colour and three more or less distinct stripes. Pleura somewhat darkened. Wings with dark subapical band. Wings with microtrichia restricted to marginal areas on upper surface, lower surface lacking microtrichia in costal, R_1, basal and most of anal cells and extreme bases of other cells. All coxae pale yellowish. Hind basitarsus about twice as long

as second tarsal segment. Male abdomen (Text-fig. 20) with two unmodified pregenital segments. Tergite nine of male with a pair of long fine points.

MATERIAL EXAMINED.

Holotype ♂, NEW ZEALAND (details in synonymy).

NEW ZEALAND: same data as holotype, 2 ♂ (paratypes); no locality (*G. V. Hudson*), 1 ♂, 1 ♀ (paratypes); Ohakune, 20.xi.1919 (*T. R. Harris*), 1 ♂; Ohakune, xi. 1922 (*T. R. Harris*), 1 ♂, 1 ♀; Ohakune, 1–9.iv.1923 (*T. R. Harris*), 1 ♂, 1 ♀; Ohakune, 2060′, 1.iii.1919 (*T. R. Harris*), 2 ♀; Ohakune, 2060′, 9.iv.1920 (*T. R. Harris*), 2 ♀; no locality, 1928 (*G. V. Hudson*), 3 ♂, 1 ♀. (All in BMNH.)

DISTRIBUTION. New Zealand.

Canthyloscelis (*Canthyloscelis*) *nigricoxa* Edwards

(Text-fig. 21)

Canthyloscelis nigricoxa Edwards, 1922 : 269. Holotype ♂, NEW ZEALAND (*G. V. Hudson*) (BMNH) [examined].

DIAGNOSIS. Eyes almost touching above antennae. Dorsum of thorax uniformly reddish. Pleurae somewhat darkened. Wings with dark subapical band. Wings with microtrichia restricted to marginal areas on upper surface and lower surface lacking microtrichia on costal, R_1, basal cells and basal areas of cells R_5 and M_2, and restricted to outer parts in cells R_4, M_{3+4}, *Cu* and anal. Hind coxae shining black, others yellowish. Hind basitarsus about equal in length to second tarsal segment. Male abdomen (Text-fig. 21) with two unmodified pregenital segments. Tergite 9 of male simple.

MATERIAL EXAMINED.

Holotype ♂, NEW ZEALAND (details in synonymy).

DISTRIBUTION. New Zealand.

Canthyloscelis (*Canthyloscelis*) *balaena* sp. n.

(Text-fig. 22)

DIAGNOSIS. Eyes narrowly separated above antennae. Dorsum of thorax uniformly light brown. Pleurae similarly coloured, becoming darker towards ventral parts. Wings with dark subapical band. Wings with microtrichia widespread on dorsal and ventral surfaces. Wings lacking microtrichia in most of costal, *Cu*, anal and basal cells and extreme bases of cells R_1 and M_2. R_1 ending beyond the level of the beginning of vein M_2. All coxae pale yellowish. Hind basitarsus more than twice length of second tarsal segment.

Male abdomen (Text-fig. 22) with two unmodified pregenital segments (the second short and narrow). Tergite 3 folded, with the fold running across the abdomen, the lateral corners forming anteriorly directed processes, apical median area strongly emarginated. Tergite 4 weakly developed and medially emarginated. Tergite 5 so heavily emarginated that it appears as two lateral semicircular plates. Tergite 6 more distorted to appear as two crescent-shaped plates joined at their antero-dorsal ends. Tergites 7 and 8 simple. Tergite 9 with short broad points separated by a shallow evenly curved emargination. Claspers very small and rounded.

MATERIAL EXAMINED.

Holotype ♂, NEW ZEALAND: 1928 (*G. V. Hudson*), no. 136q (BMNH).

DISCUSSION. The specimen was in the series of *antennata*, but from the structure of the abdomen I would regard it as closer to *nigricoxa*. The structure of the abdomen and the extensive microtrichia of the wings readily distinguish this species from the others of the *antennata*-group.

DISTRIBUTION. New Zealand.

Canthyloscelis (*Canthyloscelis*) *claripennis* Edwards

(Text-fig. 23)

Canthyloscelis claripennis Edwards, 1922 : 268. Holotype ♂, NEW ZEALAND (*G. V. Hudson*) (BMNH) [examined].

DIAGNOSIS. Eyes of male distinctly separated above antennae. Dorsum of thorax with pale ground colour and three vague, dull brown, (almost) contiguous stripes. Pleurae uniformly yellowish. Wings completely clear. Wings with microtrichia extensive on upper as well as lower surface of wing, covering entire wing except for extreme base. All coxae pale yellowish. Hind basitarsus about twice as long as second tarsal segment. Male abdomen (Text-fig. 23) with four unmodified pregenital segments. Tergite 9 with a broad simple flange.

MATERIAL EXAMINED.

Holotype ♂, NEW ZEALAND (details in synonymy).

NEW ZEALAND: Ohakune, i. 1920 (*T. R. Harris*), 1 ♂; Ohakune, 15.xii.1922–15.i.1923 (*T. R. Harris*), 1 ♀; Ohakune, v. 1922 (*J. W. Campbell*), 1 ♀. (All in BMNH.)

DISCUSSION. The second ♂ is the specimen that Edwards (1930) mentions as a fourth New Zealand species of *Canthyloscelis*.

DISTRIBUTION. New Zealand.

CHECKLIST AND PROPOSED CLASSIFICATION OF SYNNEURIDAE AND CANTHYLOSCELIDAE

Family	**SYNNEURIDAE** Enderlein, 1936
Genus	***SYNNEURON*** Lundström, 1910
	annulipes Lundström, 1910
	decipiens **sp. n.**
	silvestre Mamaev & Krivosheina, 1969
Genus	***EXILISCELIS*** **gen. n.**
	californiensis **sp. n.**
Family	**CANTHYLOSCELIDAE** Rodendorf, 1951
	Corynoscelidae Enderlein, 1912
	Hyperoscelidae Hardy & Nagatomi, 1960

Genus	***HYPEROSCELIS*** Hardy & Nagatomi, 1960
	Corynoscelis Boheman, 1858
	Spiloptera Zetterstedt, 1860
	?*Eucorynoscelis* Rodendorf, 1951
	eximia Boheman, 1858
	insignis Hardy & Nagatomi, 1960 **syn. n.**
	veternosa Mamaev & Krivosheina, 1969
Genus	***CANTHYLOSCELIS*** Edwards, 1922
Subgenus	***ARAUCOSCELIS*** Edwards, 1930
	Chiliscelis Tollet, 1959
	pectinata Edwards, 1930
	pictipennis Edwards, 1930
	apicata Edwards, 1934 **syn. n.**
	valdiviana Tollet, 1959 **syn. n.**
Subgenus	***CANTHYLOSCELIS*** Edwards, 1922
	antennata Edwards, 1922
	nigricoxa Edwards, 1922
	balaena **sp. n.**
	claripennis Edwards, 1922

SYSTEMATICS

Synneuridae and Canthyloscelidae, as treated here, consist of four very well differentiated small genera each of which has a limited distribution within the wide distribution of the group as a whole: *Synneuron* with three species and a Holarctic distribution, *Exiliscelis* with one (possibly two) Nearctic species, *Hyperoscelis* with two Palaearctic species and *Canthyloscelis* with two well marked subgenera, one with two species in the Neotropical region and one with four species in New Zealand. This is strong evidence of a relict group. They are undoubtedly related to the Scatopsidae, which is a relatively large family with a worldwide distribution and about 200 species. Some Scatopsidae, particularly *Coboldia fuscipes* (Meigen), but also such species as *Scatopse notata* (Linnaeus) and *Holoplagia guamensis* Johannsen, have been able to occupy niches over a wide distribution, both naturally and with the aid of man. The Scatopsidae, Synneuridae and Canthyloscelidae are clearly derived from the same stock, the Scatopsidae being the present day successful and versatile lineage.

The evolution of this group and the relationships of one successful group to four relict groups is of interest. In preparing the description of *Exiliscelis*, the Synneuridae and Canthyloscelidae were compared with a variety of Scatopsidae, particularly *Scatopse notata* (Linnaeus), *Aspistes berolinensis* (Meigen), *Anapausis soluta* (Loew), *Psectrosciara africana* Cook and *Ectaetia clavipes* (Loew). From this it was apparent that the Scatopsidae and *Synneuron* were almost as closely related to each other as *Hyperoscelis* is to *Canthyloscelis*. *Exiliscelis* appeared to be the most primitive genus and was more closely related to *Synneuron* than to *Hyperoscelis*. A systematic analysis of about 30 characters was prepared, dividing the various states of each character into plesiomorphic (primitive) or apomorphic (derived) condition (Hennig, 1966*b*) based on the assumption that the whole group belongs to the Mycetophiloid complex of Nematocera. These characters are

TABLE 1

Character matrix for 32 characters listed in Appendix 1

	32	28	15	13	4	29	2	12	11	16	8	1	14	22	30	5	10	3	26	24	7	9	25	31	19	18	27	17	23	6	20	1
Scatopsidae	(O)	O	O	(O)	O	(O)	(O)	(X)	X	X	X	X	X	O	O	(O)	(O)	(X)	X	X	(X)	(X)	(X)	X	X	X	X	X	X	X	(X)	(X)
Synneuron	O	O	O	O	O	X	X	O	O	O	X	X	O	X	O	O	X	X	X	X	X	X	X	X	X	O	O	O	O	O	O	O
Exiliscelis	O	O	O	O	X	X	X	O	O	O	O	O	O	O	X	X	X	O	X	X	X	X	X	O	O	O	O	O	O	O	O	O
Hyperoscelis	O	O	O	X	X	X	X	X	X	X	X	X	O	O	O	O	X	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Canthyloscelis (Araucoscelis)	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	O	X	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Canthyloscelis (Canthyloscelis)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

(X = apomorphic; O = plesiomorphic; parentheses indicate that there is some variation.)

listed in the Appendix, giving the state of each character exhibited by the Scatopsidae, followed by the alternative state in square brackets. Where the state is considered to be apomorphic it is given in italics. These can be compared with the descriptions given earlier in this paper. As might be expected in a group containing 200 species, Scatopsidae shows much more variation than in any of the other genera. This may have lead to confusion in the selection of the apomorphic state of characters, but it is to be hoped that mistakes of this type have not distorted the overall picture of relationships.

Table 1 shows a character matrix for the 32 characters examined. A representation of the probable phylogenetic relationships based on these data is given in Text-fig. 26 and this agrees with the opinion on relationships arrived at by traditional means.

By both methods the Scatopsidae are only a part of the Synneurid complex and whether the Synneuridae can continue to be maintained as a separate family must be questioned.

Further evidence may exist in the fossil record. Rodendorf (1946) described *Protoscatopse jurassica* from Jurassic material from Kara Tau, Kazakhstan, U.S.S.R. He puts it in a separate family, the Protoscatopsidae. It has not been examined in the present study, but it is obviously a specimen that should be re-examined, since Rodendorf's figures suggest some interesting characters, such as the presence of R_4

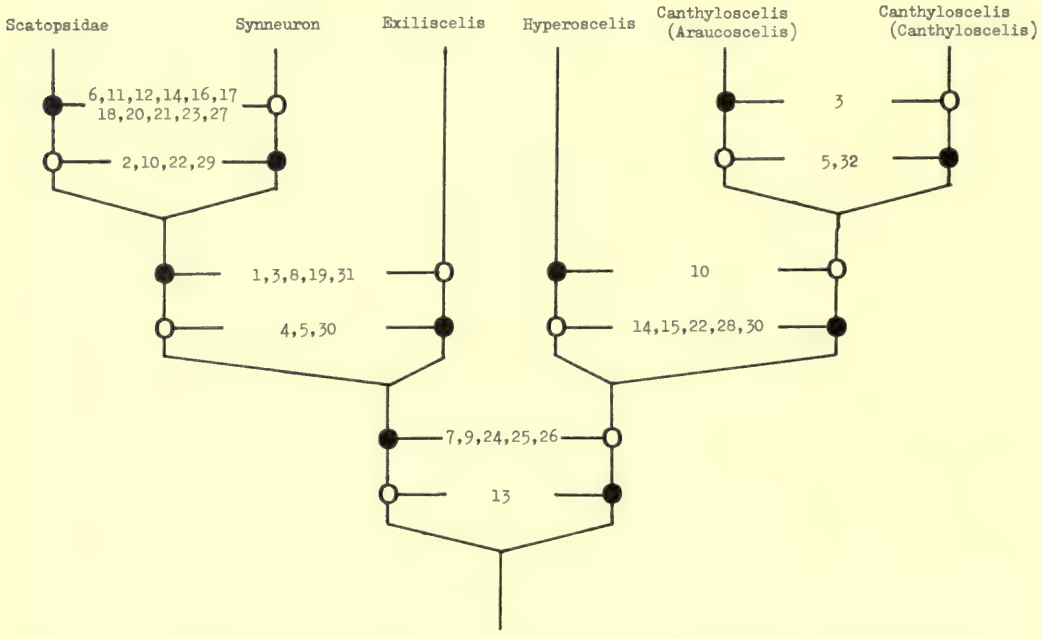


FIG. 26. Phylogenetic relationships of Scatopsidae, Synneuridae and Canthyloscelidae. Numbers refer to the characters listed in Appendix 1 and tabulated in Table 1. ● = apomorphy, O = plesiomorphy.

TABLE 2

Comparison of the larval characters of *Canthyloscelis*, *Scatopse*, Mycetophilidae and Cecidomyiidae.

Canthyloscelis	*Scatopse*	Mycetophilidae	Cecidomyiidae
Head capsule absent	Distinct head capsule	Distinct head capsule	Head capsule very small, but distinct
Near atrophy of mouthparts	Mouth parts well developed	Mouth parts well developed	Mouthparts very reduced
Body of eleven segments	Body of twelve segments	Body of twelve segments	Body of twelve segments
Integument soft, thin and colourless	Integument tough, strongly discoloured with strong hairs and granulations	Integument soft, colourless and usually thin	Integument soft, thin and colourless
Body subcylindrical	Body flattened dorso-ventrally	Body (usually) subcylindrical	Body usually slightly flattened dorso-ventrally
Spiracles sessile	Spiracles on short tubes	Spiracles sessile	Spiracles not or only slightly projecting from body
All spiracles same size and structure	Last pair of spiracles at end of long strong horns	Spiracle 1 larger than others	All spiracles same size
9 pairs of spiracles	9 pairs of spiracles	8 pairs of spiracles	9 pairs of spiracles
Last pair of spiracles on terminal segment of body	Last pair of spiracles on posterior border of penultimate segment	Last pair of spiracles on 7th abdominal segment	Last pair of spiracles on penultimate segment
Terminal armature of two heavily sclerotised horns on single adanal plate	Terminal armature of two soft processes on two isolated plates	Soft terminal lobes sometimes present	Soft terminal lobes sometimes present

A decision on the status given to these groups will eventually have to take note of the recent work on the immature stages.

EVIDENCE OF THE IMMATURE STAGES. The larva of *Canthyloscelis* was described by Tonnoir (1927*b*) and those of *Synneuron* and *Hyperoscelis* were more recently described by Krivosheina and Mamaev (1967), Krivosheina (1969) and Mamaev & Krivosheina (1969). The larvae are all similar to each other and quite distinct from known Scatopsidae. In describing the larva and pupa of *Canthyloscelis*, Tonnoir (op. cit.) listed differences between this and the larvae and pupae of Scatopsidae, Bibionidae and Cecidomyiidae. A modified summary of this, with the addition of Mycetophilidae and the exception of Bibionidae, is presented in Table 2. The Bibionidae are excepted since they are no longer regarded as a part of the Mycetophiloid complex (although the latter has been regarded as a part of the Bibiomorpha).

The most obvious feature of the larvae of *Synneuron*, *Hyperoscelis* and *Canthyloscelis* is the loss of the head capsule. The description and figures of the larvae of *Synneuron* and *Hyperoscelis* show them to have nine abdominal segments, while there are only eight in *Canthyloscelis* according to Tonnoir (1927*b*), but it is unlikely that they would differ in such a fundamental character, whilst possessing so much in common. Their shared characters are: the reduction of the head capsule to a weakly sclerotized cephalic plate with very similar antennae and an associated 'enigmatic' organ (Tonnoir, 1927*b*); the mouth opening and associated internal structures; the sessile spiracles on prothorax and eight abdominal segments, those on the prothorax and last abdominal segments being associated with a sclerotized plate; the soft thin integument with spinulose areas on the anterior region of the dorsal and ventral surfaces of the meso- and metathoracic segments and first six abdominal segments (locomotory aids); the possession of a pair of heavily sclerotized hooks set on a single adanal plate. *Synneuron* and *Hyperoscelis* show slightly greater development of the head than *Canthyloscelis* and there are other differences believed to be of generic significance (Krivosheina, 1969).

Additional information on the larvae of *Scatopse* is given in papers such as those of Morris (1918), Lyall (1929), Bovien (1935), etc. Tonnoir (1927*a*) described the larva and pupa of *Scatopse subnitens* Verrall (now considered a species of *Rhexosa*) and this is of the same basic pattern as *Scatopse*. The larva of *Ectaetia platyscelis* Loew, described by Laurence (1953), differs from the others in that the spiracles are sessile, the surface ornamentation of the body is much less conspicuous and there is a well developed adanal plate posterior and ventral to the posterior spiracles. In these respects, *Ectaetia* is reminiscent of *Synneuron* and Canthyloscelidae. Mamaev & Krivosheina (1965) have described the larvae of a wide range of genera of Cecidomyiidae, but although there are several features by which they superficially resemble *Synneuron* and Canthyloscelidae, notably the reduction of the head capsule, these similarities must be regarded as the product of convergence. The larvae of the large family Mycetophilidae show considerable variation, but still conform to the basic pattern; the literature is scattered, but papers such as Madwar (1937) and Plassmann (1972) contain a range of species.

The larvae of *Synneuron* and Canthyloscelidae differ from Scatopsidae in other

respects too. The larvae of the former live deep in rotting wood, while Scatopsidae feed in a range of decomposing vegetable and animal matter and may be predaceous. Most of the work on immature stages has been done on *Hyperoscelis*, but it is likely that the similarities in appearance are coupled with similarities in other aspects. Thus the loss of the head capsule is associated with a change to external digestion and there are associated changes in the alimentary canal to the extent that these larvae complete digestion without defecation during the growing period. The larvae of Scatopsidae have well developed mandibles and internal digestion resulting in defecation (Krivosheina, 1969). The larvae of Scatopsidae have a metapneustic first instar, amphipneustic second instar and peripneustic third and fourth instar, while *Hyperoscelis* is peripneustic throughout (Rodendorf, 1964). The nerve chord of *Hyperoscelis* and *Synneuron* consists of the normal number of ganglia, but the cord is contracted and the first abdominal ganglion is displaced into the third thoracic segment (Krivosheina, 1969). Thus the larvae of *Synneuron* and Canthyloscelidae are specialized, while the larvae of Scatopsidae are generalized.

This situation begins to reverse in the pupal stage since in Scatopsidae the last larval skin is retained as a primitive puparium, which is absent in the others.

Results. The immature stages of the Scatopsidae are quite distinct from those of the three genera *Synneuron*, *Canthyloscelis* and *Hyperoscelis*. On the other hand, the adults do not show the same division. Most of the major differences in the larvae are obviously derived from a single feature, namely the specialized feeding habit of *Synneuron* and Canthyloscelidae, but to conform to the plan of evolution expressed in Text-fig. 26 this habit must have arisen at least twice: once for the Canthyloscelid lineage and once for *Synneuron*. If *Exiliscelis* really is an older relict than the others, the discovery of its larva would be most valuable in adding to the picture. It is possible that the modifications of the larva is the means whereby this group of relicts has been able to survive.

In the absence of data on the larva of *Exiliscelis* the larval characters were not included in the phylogenetic analysis, but assuming that these characters are the product of a single apomorphy, it is unlikely to change the overall picture very much. There is ample justification on the basis of adult morphology for separating the Synneuridae and Canthyloscelidae, but if one were to accept the full force of Hennig's (1966*b*) argument, it would not be possible to separate the Synneuridae (*Synneuron* and *Exiliscelis*) from the Scatopsidae. An evolutionary classification based on the time of common ancestry would have to place Scatopsidae and *Synneuron* in the same taxon or as equivalently ranked taxa. However, the Scatopsidae are a compact and easily definable group that has apparently evolved much more rapidly and successfully than the other groups under discussion and so for convenience of classification and because of differences in their biology and evolutionary success, I prefer to retain the Synneuridae and Scatopsidae as separate families.

ZOOGEOGRAPHY

Hennig (1966*a*) used *Hyperoscelis* and *Canthyloscelis* as an example to discuss the possible routes of origin of Australasian/South American faunal relationships. He did not include *Synneuron* in this discussion. I regard the new genus, *Exiliscelis*,

as an evolutionary link between *Synneuron* and *Hyperoscelis/Canthyloscelis* and one that should be considered in any discussion on the routes of origin of the group. While the occurrence of the new genus in the Nearctic region cannot eliminate any of the possible routes suggested, it may offer an opportunity to extend the discussion and increase the probability of certain routes.

ACKNOWLEDGEMENTS

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APPENDIX: LIST OF CHARACTERS INVESTIGATED FOR PHYLOGENETIC ANALYSIS

The character investigated is followed by a statement as to the state of this character exhibited in the Scatopsidae. This is followed, in square brackets, by the alternative state. The state considered to be apomorphic is given in italics. The character state for the various Synneuridae and Canthyloscelidae can be found in the earlier text of this paper and all these data are summarized in the character matrix diagram (Text-fig. 26).

1. Head shape. *Rounded and somewhat flattened.* [Longer than broad.]

2. Ocelli. Three small equally spaced (except in Psectrosciarinae, in which *median ocellus is smaller*). [*Median ocellus reduced or absent.*]

3. Eyes. *Meet over antennae* (except in *Lumpuria*, ♀ *Colobostema* and Aspistinae), well separated below. [Narrowly separated above antennae.]
4. Antennae. *7–12 short closely jointed segments* covered with small setae and whorls of rather larger setae (except in *Lumpuria*, in which flagellar segments are quite long and the 10-segmented antennae are at least as long as the head and thorax). [16-segmented antennae.]
5. Gena. Not developed (except in *Swammerdamella*). [Well developed.]
6. Mouthparts. *1-segmented maxillary palp*, 1 median or small pair of cradostipites, proboscis with prominent labellae (single pseudotrachea in *Ectaetia* only). [4-segmented palps, labellae prominent or inconspicuous.]
7. Thorax shape. *Elongate and laterally compressed* (not so much in genera such as *Holoplagia*, *Colobostema* and *Parascatopse* (Scatopsinae), *Lumpuria* and Aspistinae; very narrow and elongate in *Psectrosciara*). [Stoutly developed.]
8. Prothorax. *Stoutly developed.* [Reduced but forming a distinct collar.]
9. Anterior spiracle. *On separate sclerite* in Scatopsinae and *Lumpuria*. On anepisternite in others, but *partly separated* in Psectrosciarinae and Ectaetiinae. [On anepisternite.]
10. Sternopleuron and meron. Sternopleuron only slightly larger than meron in Scatopsinae (better developed and meron less well developed in Aspistinae, Ectaetiinae and Psectrosciarinae respectively). [*Sternopleuron prominent, meron very small.*]
11. Scutellum. *Well developed and prominent.* [Poorly developed, not prominent.]
12. Fore coxae. *Short* (long in *Psectrosciara*, also in Ectaetiinae and Aspistinae). [Long.]
13. Legs. Unremarkable (Tibia sometimes modified, e.g. *Aspistes*). [*Swollen hind femora*, tibia curved to fit femur.]
14. Tibial spurs. *True spurs ? not present*, usually a weak tibial comb, sometimes suggestive of spurs. [*Well developed comb* or distinct spurs present.]
15. Tarsal claws. Simple. [*Large basal lobe with small teeth.*]
16. Empodium. *Large and setaceous.* [Narrow, fringed.]
17. Wings. *Short and broad with well developed anal lobe.* [Longer and narrow, anal lobe absent.]
18. Wing vein pigmentation. *Costa, radius and base of media pigmented, rest weak.* [Posterior veins well developed and well pigmented.]
19. Vein R_4. *Absent* [Present or represented by a fusion.]
20. Vein *r-m*. *Absent* (Cross-vein in some *Scatopse* and *Holoplagia* is called *r-m*, but may not be homologous). [Represented by a fusion.]
21. Vein M_1. Sometimes *interrupted at base.* [Complete.]
22. Vein M_2. Complete. [*Interrupted at base.*]
23. Vein *m-cu*. *Absent.* [Present or represented by a fusion.]
24. Vein Cu_2. *Absent.* [Weakly present.]
25. Anal vein. Present or *absent.*
26. Vein *Sc*. *Sometimes weakly present.* [Faint to well developed.]
27. Costa. *Ends at end of* R_5. [Extended beyond end of R_5.]
28. Number of unmodified pregenital segments. Seven. [*Reduced.*]
29. Male sperm pump. Attached to genital complex in all but Scatopsinae, in which it is *free in abdomen.*
30. Male sperm pump. Not encapsulated. [*Encapsulated.*]
31. Ovipositor. *One-segmented.* [Two-segmented.]
32. Spermatheca. One, simple (*modified* in *Ectaetia*.)

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A TAXONOMIC REVISION OF THE GENUS *CALLIPIELUS* BUTLER (LEPIDOPTERA : HEPIALIDAE)

G. S. ROBINSON

BULLETIN OF
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ENTOMOLOGY Vol. 35 No. 4
LONDON : 1977

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SYNOPSIS

The genus *Callipielus* Butler (Lepidoptera: Hepialidae) is redescribed and redefined. Nine species are described, four of them new; one new generic and one new specific synonym are established. Keys to the species are given and the morphology and phylogeny of the genus are discussed: the fossil history of the Hepialidae is reviewed.

INTRODUCTION

THE genus *Callipielus* was erected by Butler (1882) to accommodate a single species and remained in obscurity for many years. A revision of this genus, with the recognition of nine species, has been undertaken as several of the constituent species are now found to be involved with other Hepialidae in causing severe damage to pasture in South America. The opportunity has been taken here to discuss the morphology of the male genitalia of Hepialidae and to draw attention to two fossil Hepialidae from the Isle of Wight 'insect limestone' deposits.

All primary types except one have been examined; in the case of *C. chiliensis* the original description is sufficient for identification.

Size measurements given are the wing span of a specimen set in conventional fashion.

The terminology used in descriptions of male and female genitalia follows Klots (1956) (but see 'Morphology'). Genitalia dissections were made and subsequently mounted in conventional fashion; in this group, however, it is necessary to remove

and mount separately the anal tube and ductus ejaculatorius and to cut the intromittent organ (composed of the fused tegumen and juxta) longitudinally along the caudal surface and continue the cut past the socii and uncus so that the caudal sclerites and the apex of the tegumen may be displayed when the intromittent organ is 'unrolled'. Chlorazol Black E was used for staining preparations and Euparal was employed as a mounting medium.

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ABBREVIATIONS

BMNH	British Museum (Natural History)
MNHU	Museum für Naturkunde der Humboldt-Universität, Berlin
MNS	Museo Nacional de Historia Natural, Santiago
NR	Naturhistoriska Riksmuseet, Stockholm
RNH	Rijksmuseum van Natuurlijke Historie, Leiden

CHECKLIST OF *CALLIPIELUS* SPECIES

CALLIPIELUS Butler
  Stachyocera Ureta **syn. n.**
  arenosus Butler
    leukogramma Bryk **syn. n.**
  chiliensis Viette
  digitata **sp. n.**
  brunnescens **sp. n.**
  castilloi **sp. n.**
  salasi **sp. n.**
  izquierdoi (Ureta) **comb. n.**
  argentata Ureta
  sp. indet.

* Holotype not examined.

GEOGRAPHICAL DISTRIBUTION

Callipielus is an exclusively Neotropical genus restricted in its distribution to southern Chile and Argentina. All known specimens (with one exception) originate from an area extending 700 km south from latitude 35°S and extending 250 km east from the coast. The altitude of collecting localities ranges from sea level up to 1800 m. The limited altitudinal data available suggest that *Callipielus* is not only

found in lowland subtropical ('Mediterranean') conditions between Santiago and Puerto Montt but is also associated with temperate upland pastures with higher rainfall. The area occupied by the genus has been little-collected and it is likely that *Callipielus* will be shown to have a continuous range southwards to Tierra del Fuego (from where a single specimen of *C. arenosus* is known).

BIOLOGY

Callipielus species are grass-feeders and, in common with other Hepialidae, notably *Dalaca* spp., cause extensive damage to pastures in Patagonia (Castillo, *in litt.*). Dr Castillo is currently studying the biology of the Patagonian Hepialidae involved in the damage of pasture.

Specimens of *Callipielus* are rare in collections and label data giving months of collection are sparse. All specimens examined have been collected between December and May (the southern hemisphere summer and autumn) with the exception of *Callipielus castilloi* which was collected in July (the southern winter).

MORPHOLOGY

The morphology of *Callipielus* is described in detail below but comment is required on the male genitalia.

Eyer (1921) attempted to homologize the male genital structures of Hepialidae with the male genitalia of Noctuidae described by Pierce (1909). Eyer revised and expanded this work (1924). In this latter paper the aedeagus was misidentified. The sclerotized portion of the diaphragma between the valves was identified as the juxta and other ventrocaudal sclerotization anterior to the anus and 'penis' (which organ had, apparently, nothing to do with the aedeagus) was termed the 'suspensorium'.

Philpott (1927) corrected Eyer's misinterpretation of the aedeagus and named the sclerotised plate or flap referred to by Eyer as the aedeagus the trulleum. His interpretation of the juxta followed that of Eyer: he described the trulleum as articulated with the caudal margin of the juxta and more or less fused or 'strongly attached to' the ventral extremities of the tegumen. Philpott's drawings are crude and difficult to interpret.

Pierce & Beirne (1941) described the genitalia of *Hepialus* and identified parts of the tegumen as gnathos and uncus: the uncus was described as a portion of the eighth segment.

Viette (1947) gave a general description of Hepialid genitalia and followed Philpott's nomenclature: this was retained in his review of Lepidoptera genitalia (1948) in which he interpreted the trulleum as a sclerotization of the membrane between the penis and the juxta—the manica (sic). He pointed out the absence of the trulleum in *Charagia* and *Leto*.

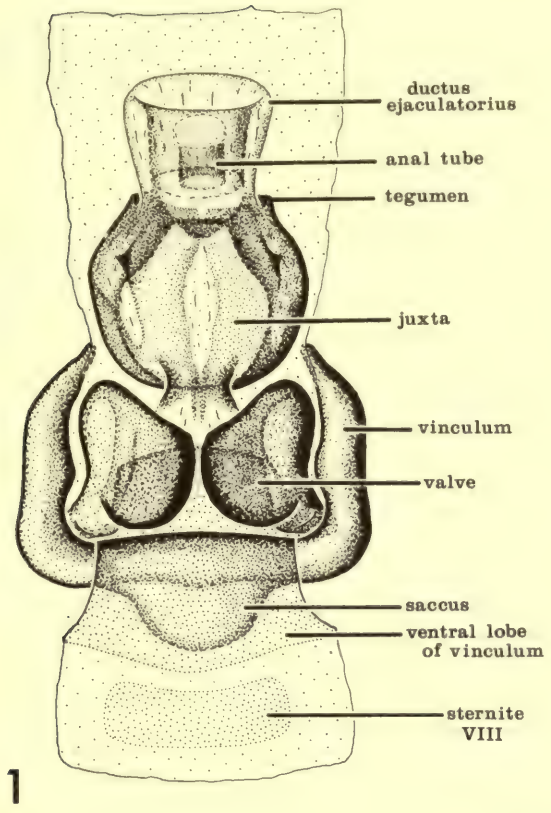
The nomenclature and homology of Hepialid genitalia has thus had an inauspicious beginning and several misconceptions remain. Eyer's 'suspensorium' is an unnecessary and uninformative term. Ventral sclerotization of the diaphragma between the anogenital opening and the vinculum may be homologous with or

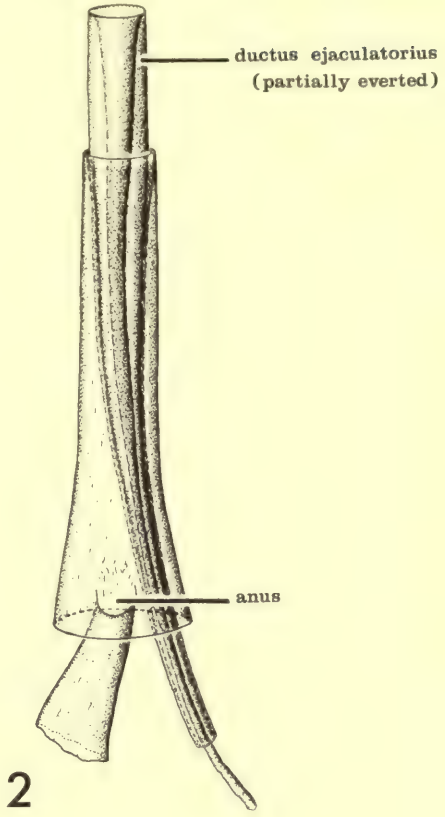
analogous to the tegumen (in the form of a ventral extension) or the juxta of other Lepidoptera. In that the juxta is a sclerotized plate ventrad of the aedeagus which it helps to support (Klots, 1956), any sclerotization in this region not attributable to the tegumen might, by analogy, be termed juxta. Pierce & Beirne's 'gnathos' and 'uncus' (above) are erroneous and should be ignored. The Hepialid trulleum (of Philpott and Viette) is thus, by analogy, part of the juxta. The form of this sclerotization is extremely variable and may not be homologous in different Hepialid genera. In *Callipielus* it forms a tube running anteriorly-posteriorly and opening internally at both ends. In this form it may act as a passage for a muscle through the deep fold of cuticle at the anterior base of the intromittent organ. It does not carry the ductus ejaculatorius. It may be a separate sclerite from that between the valves (juxta *auctorum*) and in some genera, including *Callipielus*, is inseparably fused with the tegumen and extended a long way ventrad along the intromittent organ (it cannot be accepted that the tegumen—ninth tergite—extends completely beneath the anogenital aperture). It should be noted here that Viette's (1948) use of the term 'manica' for the membrane of which the trulleum is a sclerotization is erroneous.

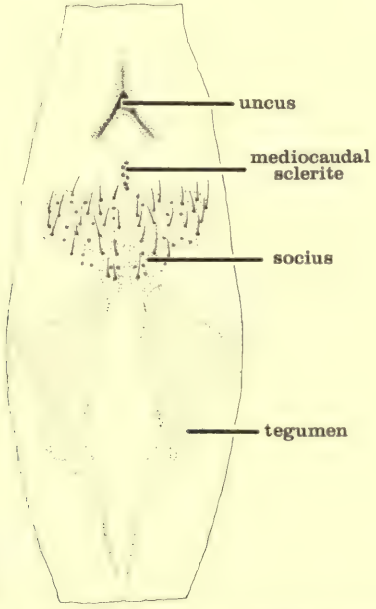
It may not be possible to safely homologize the juxta (*sensu* Eyer, Philpott, *et alia*) or the trulleum of Hepialidae with the juxta of other families of Lepidoptera. In this work I interpret and describe the trulleum and its caudal sclerotized extension as the juxta. The sclerotization of the diaphragma between the valves is described as such.

Text-fig. 1 illustrates schematically the male genitalia of *Callipielus*. Features which should be noted are the reduced eighth sternite and the ventral and anterior extension of the vinculum. The intromittent organ, composed of tegumen and juxta, has been tipped posteriorly to expose the pinched base of the juxta: the membranes of the common anogenital aperture (ductus ejaculatorius) have been slightly everted. The anal tube is dorsal to the inturned ductus ejaculatorius and runs parallel with it: the anus opens into the common aperture. Text-fig. 2 illustrates schematically the partially everted aedeagus in dorsal view. The membrane has been severed just beyond the margin of the juxta and tegumen and the ductus ejaculatorius has been removed with the anal tube. The aedeagus is formed from the progressively tapered ductus ejaculatorius (which is about 16 mm long) folded back into itself five times (three times when partially everted as illustrated). It is unlikely that the ductus ejaculatorius is fully everted during copulation as the female ductus bursae is only about 8 mm long. Philpott (1927) suggested that the Hepialid anus was imperforate: he appears to have been mistaken.

Text-fig. 3 illustrates the caudal extremity of the genitalia of *Callipielus*. There are four sclerites beyond the tip of the tegumen and I interpret these as derivatives of the tenth tergite (see Klots, 1956). Adjacent to the caudal margin of the tegumen are two setose sclerites which are also present in several other genera (e.g. *Dalaca*). I hesitantly interpret these as analogous to and possibly homologous with the socii of other families. Caudal to the socii and placed medially is a very small sclerite bearing a few setae. It may or may not be present in specimens of the same species and its significance is not clear. It is here termed the mediocaudal sclerite. The







FIGS 1–3. Schematic diagrams of (1) male genitalia of *Callipielus* (ductus ejaculatorius slightly everted; caudal sclerites obscured); (2) partially everted aedeagus of *Callipielus* (dorsal view); (3) caudal sclerites of *Callipielus*.

most caudal sclerite, the uncus, is of very variable form in *Callipielus* and usually forms a shallow invaginated pocket. Its homology with the uncus in other families is doubtful, its analogy as the extreme caudal sclerite precise. The caudal sclerites of Hepialidae do not appear to have been previously described.

PHYLOGENY

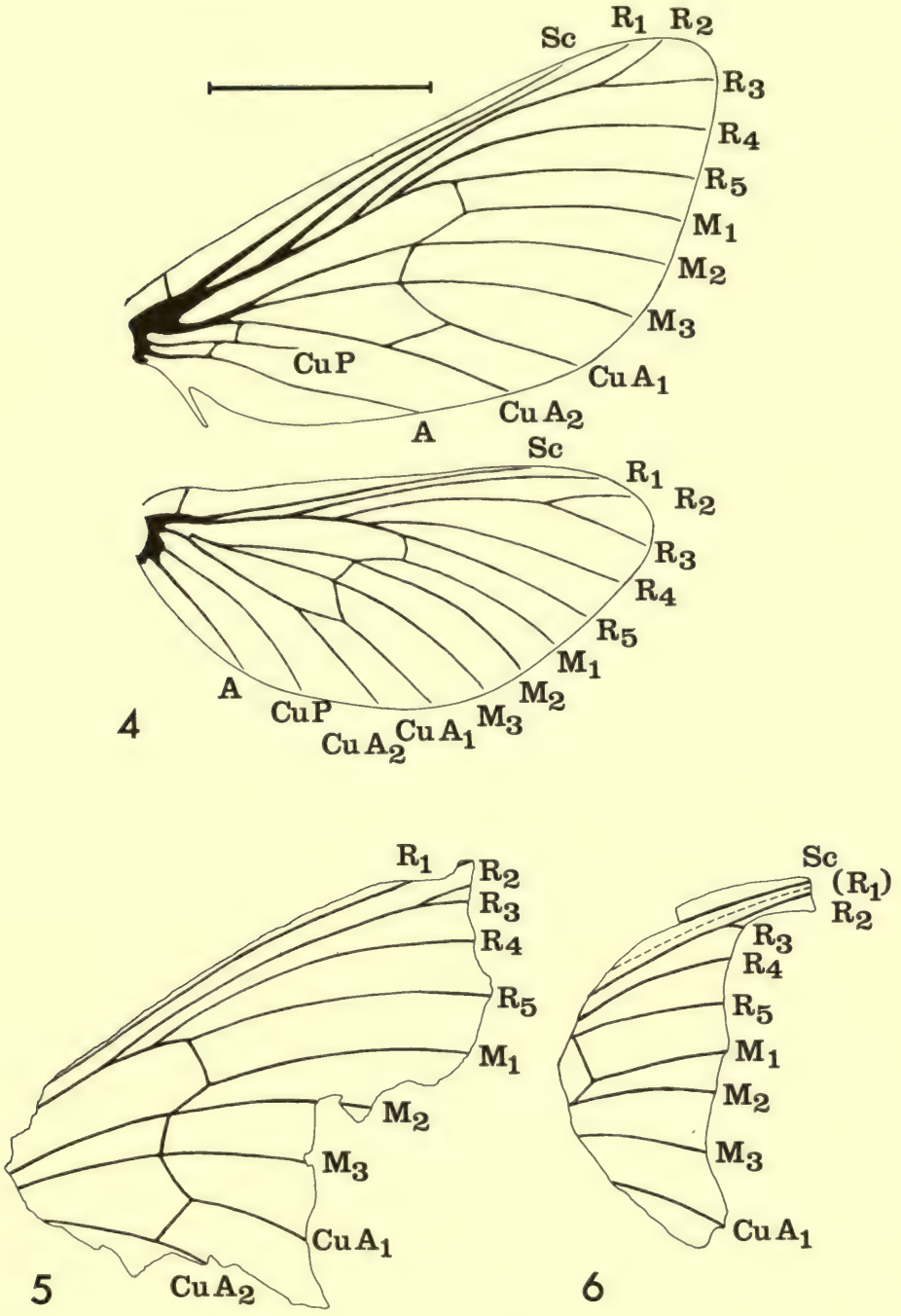
Pierce (1945) described a fossil Hepialid from the Upper Miocene of California. The interpretation of this fossil is open to question. There are two fossil Hepialid fore wing fragments in the collection of the Palaeoentomology Section, BMNH, from the Isle of Wight 'insect limestone' deposits (about 40 million years BP). The more complete wing fragment (registration no. In. 17464—Text-fig. 5) exhibits typical Hepialid venation comparable with that of *Callipielus* (Text-fig. 4) and many other Hepialid genera and represents a fore wing of about the same size as that of one of the larger *Callipielus* specimens. The second fossil wing fragment (registration no. In. 64528—Text-fig. 6) is less complete; it is folded anteriorly so that R_1 is concealed and there are scale impressions on the atypically broad costa. Typical venation and size has, therefore, at least a 40 million year history in the Hepialidae.

No marked gradation from primitive to advanced forms has been identified in living Hepialid genera but Tindale (1941) isolated *Zenophassus* Tindale as a separate subfamily (Zenophassinae) within the Hepialidae on the grounds that it exhibited 'some of the most primitive features yet found in the Lepidoptera'. *Zenophassus* has a five-segmented maxillary palpus, very large mandible, forked subcostal vein, complete fore wing post-cubitus and large eighth sternite in the male; the antenna has 23–28 small, cylindrical segments. Several features of *Zenophassus* are, however, specialized: an epiphysis is lacking, the hind leg is modified and bears a scent-organ, the uncus is absent and the socii are represented (if at all) by a sparsely setose zone on the caudal membrane. The labial palpus of *Zenophassus* has only two segments, the third segment being lost. Tindale's 'mandible' is the projecting cardo and his 'post-antennal organ' is the mandible.

Callipielus exhibits a mixture of primitive and derived characteristics contrasting with those of *Zenophassus*: the maxillary palpus has a single segment, the mandible is small, the subcostal veins are unbranched, the fore wing post-cubitus is reduced and the eighth sternite is reduced or absent; the antenna has up to sixty segments which are not simple as in *Zenophassus*. *Callipielus* has retained a three-segmented labial palpus, an epiphysis, a simple hind leg, socii and an uncus. The shape and structure of the juxta-tegumen intromittent organ of *Callipielus* is peculiar and, with the combination of characters given above, separates the genus from other Hepialidae.

Pfitzner & Gaede (1937) placed *Pielus* (now *Parapielus*) *luteicornis* Berg close to *Callipielus* but in *Parapielus* the first and second segments of the labial palpus are fused (not separate as figured by Viette, 1949), the antenna has 33 segments and the maxillary palpus is reduced and entirely membranous. The ventral lip of the juxta-tegumen complex of *Parapielus* is spout-shaped as in many other genera and the valves are elongate and only lightly sclerotized.

Callipielus appears, therefore, to occupy an isolated position within the Hepialidae;



FIGS 4–6. Venation of (4) *Callipielus arenosus* Butler, ♂, Argentina (scale line = 1 cm); (5) fossil Hepialid fore wing fragment, specimen no. In. 17464, Isle of Wight (scale as Text-fig. 4); (6) fossil Hepialid fore wing fragment, specimen no. In. 64528, Isle of Wight (scale as Text-fig. 4).

its affinities with *Parapielus* should not be over-emphasized. There is a need for a modern higher classification of the Hepialidae involving critical morphological investigation of currently recognized genera and evaluation of the occurrences of primitive or unspecialized characteristics among the genera.

Text-fig. 7 illustrates my concept of the phylogeny of the currently recognized *Callipielus* species. I am unable to place the taxon represented only by females. Male genital morphology has been used as the basis for this postulated phylogeny.

CALLIPIELUS Butler

Callipielus Butler, 1882, *Trans. ent. Soc. Lond.* **1882** : 23. Type-species: *Callipielus arenosus* Butler, 1882, *ibidem* **1882** : 24, by monotypy.

Callipielus Butler; Pfitzner & Gaede, 1937 : 1298 [redescription].

Callipielus Butler; Viette, 1950*a* : 52 [redescription].

Stachyocera Ureta, 1957, *Boln Mus. nac. Hist. nat. Chile* **27**(2) : 159. Type-species: *Stachyocera izquierdoi* Ureta, 1957, *ibidem* **27**(2) : 159, by original designation and monotypy. **Syn. n.**

Antenna 6·5–11·0 mm long, with 38–63 segments; basal segment swollen, remainder angular (Pl. 6, fig. 30), bipectinate (Pl. 6, fig. 33) or barrel-shaped (Pl. 6, fig. 36). Vertex with pair of lateral thorn-like processes, two pairs of shallow, nodular projections towards antennal bases. Tentorial pits at one half of lateral margin of frontoclypeus, near antennal bases; labrum lightly sclerotized with two pairs of dorsolateral sensory pits. Epipharynx not defined, mandible present, about 0·1 mm long, thinly sclerotized. Maxillary palpus with single, short, conical segment three-quarters length of mandible. Stipes membranous, cardo sclerotized and nodular. Labium (Pl. 6, fig. 37) oval, 0·35 × 0·50 mm, dorsal surface with longitudinal groove terminating between basal segments of three-segmented labial palpi. First, second and third segments of labial palpus approximately 1·0, 1·1 and 0·4 mm long respectively. Head covered with elongate, pale scales, scales blackish around eyes. Labial palpus with short, stiff scales. Thorax densely clothed with fine hairs. Legs clothed with short hairs, longer on femur. Fore leg one-tenth longer than hind leg, mid leg one-fifth longer. Fore femur one-fifth longer, mid

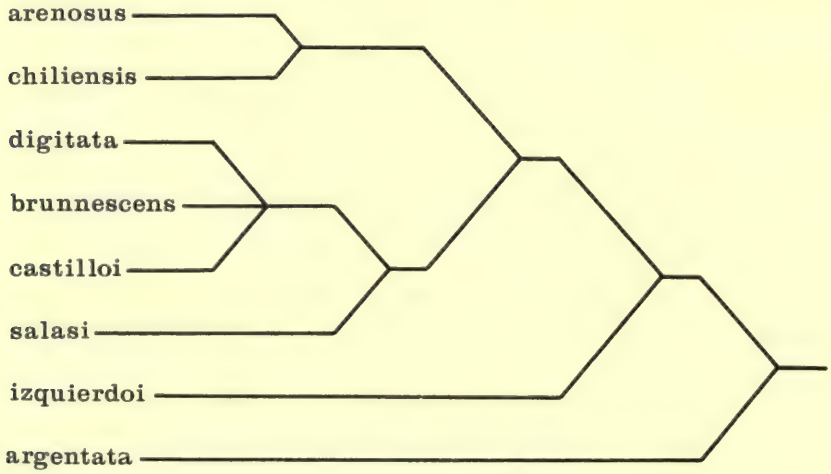


FIG. 7. Suggested phylogeny of *Callipielus*.

femur one-quarter to two-fifths longer than hind femur; fore tibia slightly longer, mid tibia one-fifth longer than hind tibia; tarsi of approximately equal length. Femur of each leg approximately as long as tibia; tibia nine-tenths to three-fifths length of tarsus, hind tibia always proportionately shortest, four-fifths to three-fifths length of hind tarsus. First to fifth tarsal segments with length ratio approximately 1 : 0·6 : 0·4 : 0·4 : 0·5. Epiphysis (Pl. 6, fig. 38) one-half length of tibia (one-quarter length in *Callipielus* sp. indet.), triangular, flap-like, with dense field of microtrichia on internal surface. Tarsal claws strongly developed on all legs, 0·4–0·6 mm long. Fore wing 19–35 mm long, yellowish or brownish with bold, paler markings (not well-defined in *C. chiliensis*) forming a distinctive pattern (Pl. 1, figs 1–8); subterminal line of transverse, pale streaks always well-defined. Costa straight, slightly convex towards apex; termen curving evenly and continuously with posterior margin. Venation as in Text-fig. 4: *Sc* unbranched, R_2 and R_3 stalked from two-thirds to four-fifths, *M* complete, forked, arising from *CuA*, basal half of *CuP* present in fore wing. Hind wing orange to greyish brown, basally reddish or yellowish in several species, in some species with pale subterminal spots; underside of hind wing with dense hair in subcostal field.

Genitalia ♂. Eighth sternite present, small, relatively heavily sclerotized, showing tendency towards separation into pair of lateral sclerites, but absent in *C. izquierdoi*. Saccus semicircular, heavily sclerotized. Ventral lobe from vinculum overlying saccus, heavily sclerotized. Vinculum stout, U-shaped. Valve stout, kidney-shaped, triangular, or narrow with inturned tip, heavily sclerotized and densely setose. Base of juxta pinched to form tube (but tube not closed caudally in *C. argentata*). Tegumen and caudal region of juxta completely fused, forming large, globose intromittent organ; juxta with weakly sclerotized ventral crease or medial emargination (the latter particularly conspicuous in *C. izquierdoi*), with or without lateral digitate processes. Tegumen extended caudally as a sideways T-shaped sclerotization, ventral branch of 'T' produced into heavily sclerotized digitate process in several species. Pair of socii [see 'Morphology'] adjacent to dorsal margin of tegumen, with or without minute, setose mediocaudal sclerite. Uncus, if present, a more or less heavily sclerotized fold in caudal abdominal membrane, Y-shaped or slit-like. Aedeagus membranous, scobinate at base, consisting of infolded ductus ejaculatorius; base of ductus ejaculatorius distal to anus with pair of shallow, bulbous lateral swellings and dorsomedial swelling, base of dorsomedial swelling lightly sclerotized.

Genitalia ♀. Eighth segment complete, with fully developed spiracle, eighth sternite small. Ninth sternite heavily sclerotized, tapered posteriorly, with doubly peaked apex. Papillae anales large, triangular or quadrangular. Apophyses absent. Ductus bursae with fine transverse constrictions; bursa copulatrix without signum.

Key to Males

1 Antennal segments bipectinate (Pl. 6, fig. 33) . . . . . ***salasi*** (p. 117)
– Antennal segments angular (Pl. 6, figs 30–32, 34, 35) 2
2 Valve narrow and elongate with inturned tip (Pl. 3, fig. 17) . . ***argentata*** (p. 118)
– Valve broad and short, triangular or kidney-shaped, tip not turned inwards . . 3
3 Wing expanse less than 50 mm, fore wing with black streak on posterior margin (Pl. 1, fig. 7); juxta with deep medial emargination (Pl. 3, fig. 16) ***izquierdoi*** (p. 117)
– Wing expanse greater than 50 mm, fore wing without black streak on posterior margin; juxta without deep medial emargination or only with weakly sclerotized medial line 4
4 Ventral lobe of vinculum with pair of conical digitate processes towards anterior margin but without transverse ridge 5
– Ventral lobe of vinculum without conical processes but with transverse ridge . . 6
5 Fore wing with bold silvery white markings (Pl. 1, fig. 1); socii separate ***arenosus*** (p. 112)
– Fore wing without bold silvery white markings (Pl. 1, fig. 2); socii fused together ***chiliensis*** (p. 113)

6 Fore wing with conspicuous bold white markings (Pl. 1, fig. 3); digitate process from ventral arm of tegumen claw-shaped (Pl. 2, fig. 12) . . . . ***digitata*** (p. 114)
– Fore wing without conspicuous white markings; digitate process from ventral arm of tegumen short and tooth-like or stout and blunt (Pl. 2, fig. 13, Pl. 3, fig. 14) . 7
7 Base of hind wing dull yellowish brown, fore wing without narrow silvery subterminal line (Pl. 1, fig. 4); eighth sternite constricted medially, digitate process from ventral arm of tegumen stout and blunt (Pl. 2, fig. 13) . . ***brunnescens*** (p. 115)
– Base of hind wing pinkish, fore wing with silvery subterminal line (Pl. 1, fig. 5); eighth sternite not constricted medially, digitate process from ventral arm of tegumen short, tooth-like (Pl. 3, fig. 14) . . . . . ***castilloi*** (p. 116)

Key to Females

Females of *chiliensis, digitata, brunnescens, castilloi, salasi* and *argentata* are unknown.

1 Epiphysis one-quarter length of tibia; antennal segments barrel-shaped (Pl. 6, fig. 36) . . . . . sp. indet. (p. 119)
– Epiphysis one-half length of tibia; antennal segments angular 2
2 Papillae anales triangular, overlapping ninth sternite which has pointed tips (Pl. 5, fig. 28) . . . . . ***arenosus*** (p. 112)
– Papillae anales quadrangular, not overlapping ninth sternite which has rounded tips (Pl. 5, fig. 29) . . . . . ***izquierdoi*** (p. 117)

Descriptions of Species

Callipielus arenosus Butler

(Pl. 1, fig. 1; Pl. 2, fig. 10; Pl. 3, fig. 18; Pl. 5, figs 26, 28; Pl. 6, fig. 30)

Callipielus arenosus Butler, 1882, *Trans. ent. Soc. Lond.* **1882** : 24, pl. 1, fig. 6. LECTOTYPE ♂, Chile: [Valdivia (*Edmonds*)] (genitalia slide no. 12348; BMNH), here designated [examined].
Callipielus arenosus Butler; Viette, 1950*a* : 52, fig. 1 [redescription].
Callipielus leukogramma Bryk, 1945, *Ark. Zool.* **36**A(3) : 26, pl. 2, figs 15, 16. Holotype ♂, Argentina: Lago Nahuel Huapí, Llau Llau Peninsula, N. of Puerto Nuevo, 770–780 m, x.1933–iii.1934 (*Lundblad*) (genitalia slide no. S-02; NR, Stockholm) [examined]. **Syn. n.**

♂. 51–61 mm. Antenna with 46–49 angular segments (Pl. 6, fig. 30). Head buff-brown, labial palpus with darker lateral scales. Thorax and tegula buff-brown. Fore wing dark brown and ochreous brown with bold silvery white markings picked out with dark brown margins. Hind wing greyish brown with paler, diffuse subterminal maculae; base of hind wing and anal angle yellow. Legs light buff-brown, darker and greyish above. Epiphysis one-half length of tibia.

♀. 70, 75 mm. Antenna with 43 angular segments (one specimen only examined). Similarly patterned to ♂.

Genitalia ♂ (Pl. 2, fig. 10; Pl. 3 fig. 18; Pl. 5, fig. 26). Eighth sternite 0·9–1·6 × 0·3 mm. Ventral lobe of vinculum with pair of densely sclerotized, short, conical, digitate processes towards anterior margin. Saccus one-half to two-thirds as wide as vinculum. Valve blunt, triangular, heavily sclerotized and setose, with well-defined dark transverse ridge across outer surface. Sclerotized region of diaphragma between valves quadrate, anterior corners extended laterally. Juxta completely fused with tegumen, sclerotization extended to caudal lip of intromittent organ; posterior lateral processes of juxta semicircular, shallow, with saw-toothed edge. Ventral arm of tegumen 'T' very narrow, elongate. Socii large, setose. Small mediocaudal sclerite present or absent. Uncus a crescentic, heavily sclerotized pocket (distinctly Y-shaped in genitalia slide S-02).

Genitalia ♀ (Pl. 5, fig. 28). Ninth sternite large (1·80 × 1·30, 1·60 × 0·95 mm). Papillae anales triangular, overlapping ninth sternite.

REMARKS. *C. arenosus* is closely allied to *C. chiliensis* but the latter species has a very different wing pattern, lacking the bold silvery white markings of *arenosus*. The male genitalia of the two species are very similar but the ventral arms of the tegumen 'T' are shorter and broader in *chiliensis* than in *arenosus*; in *arenosus* the socii are not fused medially and the uncus does not form a deep and rather square pocket, longer than wide, as in *chiliensis*. The type-series of *C. leukogramma* and a single male of *arenosus*, all in NR, Stockholm, carry labels reading 'Patagonien 1932–34 Lago Nahuel Huapí Exp. *Ljungner*'. Full locality data as cited for the holotype (above) are taken from Bryk (1945).

DISTRIBUTION. Chile, Argentina.

MATERIAL EXAMINED.

ARGENTINA: 1 ♀, 'taken laying on wet turf near a stream in open rega', 24.xii.1931 (*Reynolds*) (genitalia slide no. 12349; BMNH); 2 ♂, 1 ♀ (including allotype and paratype of *leukogramma*), Lago Nahuel Huapí, Llau Llau Peninsula, N. of Puerto Nuevo, 770–780 m, x.1933–iii.1934 (*Lundblad*) (genitalia slide nos S-01, S-03; NR, Stockholm). CHILE: 1 ♂, Tierra del Fuego, Rio McLelland, 24.xii.1904 (*Crawshay*) (genitalia slide no. 12351; BMNH).

Callipielus chiliensis Viette

(Pl. 1, fig. 2; Pl. 2, fig. 11; Pl. 3, fig. 19)

Callipielus chiliensis Viette, 1950, *Zoöl. Meded., Leiden* **31** : 74, figs 16, 17, 18. Holotype ♂, CHILE: Valdivia, i.1938 (*Andreas & de Graag*) (genitalia slide no. 2187 [Viette]; RNH, Leiden) [not examined].

[*Callipielus arenosus* Butler, 1882 : 24 (partim—1 ♂ only). Misidentification.]

♂. 75 mm. Antenna with angular segments (number unknown). Head greyish, labial palpus darker, brownish. Thorax and tegula buff-brown. Fore wing yellowish brown, darker at costa, with silvery white medial streak close to posterior margin; dark brown diffuse subterminal line, reniform stigma and small streak between reniform and posterior margin; line of small, yellowish spots at termen. Hind wing ochreous brown with subterminal and terminal lines of minute, paler spots; base of hind wing and anal angle yellowish. Legs light buff-brown, darker and greyish above. Epiphysis one-half length of tibia.

♀. Unknown.

GENITALIA ♂ (Pl. 2, fig. 11; Pl. 3, fig. 19). Eighth sternite 1·3 × 0·5 mm, trapezoidal, anterior margin 0·8 mm long. Ventral lobe of vinculum with pair of densely sclerotized, short, conical, digitate processes towards anterior margin. Saccus one-half as wide as vinculum. Valve blunt, triangular, heavily sclerotized and setose, with anterior depression in ventral surface, caudal margin of depression a densely sclerotized ridge. Sclerotized region of diaphragma between valves trapezoidal. Juxta completely fused with tegumen, sclerotization extended to caudal lip of intromittent organ; posterior lateral processes of juxta semicircular, shallow, with saw-toothed edge. Ventral arm of tegumen 'T' broad, rather blunt. Socii large, setose, only lightly sclerotized, fused medially. Mediocaudal sclerite absent. Uncus small, a shallow V-shape, with small invaginated membranous pocket which is longer than wide.

REMARKS. *C. chiliensis* is closely allied to *C. arenosus* but lacks the bold silvery white markings of the latter species. For details of differences in the male genitalia

see 'Remarks' for *arenosus*. *C. digitata* differs from *chiliensis* in that the juxta of *digitata* has a small medial emargination and is without posterior lateral processes and the bases of the ventral arms of the tegumen are evaginated to form a stout, dark, claw-like digitate process. *C. digitata* has much darker fore wings than *chiliensis*.

DISTRIBUTION. Chile.

MATERIAL EXAMINED.

CHILE: 1 ♂, (*Edmonds*) (genitalia slide no. 12350; BMNH) (paralectotype of *arenosus*).

Callipielus digitata sp. n.

(Pl. 1, fig. 3; Pl. 2, fig. 12; Pl. 4, fig. 20; Pl. 6, figs 31, 38)

[*Callipielus arenosus* Butler; Pfitzner & Gaede, 1937 : 1298, pl. 185, fig. e (partim—1 ♂ only). Misidentification.]

♂. 69 mm. Antenna with angular segments (Pl. 6, fig. 31) (number unknown). Head whitish, scales tipped with dark brown but completely brown adjacent to eyes, labial palpus greyish brown. Thorax and tegula dark grey-brown anteriorly, metathorax pale yellowish brown. Fore wing dark chocolate-brown patterned with cream and light ochre, distinctive cream triangle at end of cell and pair of basal posterior comma-shaped marks. Hind wing light greyish brown without light subterminal spots, veins darker; base of wing and anal angle dull yellowish with slight pink tint. Legs light greyish brown, slightly darker above. Epiphysis one-half length of tibia (Pl. 6, fig. 38).

♀. Unknown.

GENITALIA ♂ (Pl. 2, fig. 12; Pl. 4, fig. 20). Eighth sternite small, 0·85 × 0·20 mm, distinctly narrowed medially. Ventral lobe of vinculum with densely sclerotized transverse ridge a little beyond one-half anteriorly. Saccus one-half as wide as vinculum. Valve blunt, triangular, densely sclerotized and setose, with shallow depression in outer surface, posterior corner swollen to form slight hump extending one-third length of posterior margin, hump polished, without setae. Lightly sclerotized region of diaphragma between valves apparently ovate. Juxta completely fused with tegumen, relatively lightly sclerotized but darker posteriorly, sclerotization extended to caudal lip of intromittent organ but with small medial emargination and weakly sclerotized medial line posteriorly; posterior lateral processes of juxta absent. Ventral arm of tegumen 'T' narrow, elongate, but weakly sclerotized and ill-defined; base of ventral arm with densely sclerotized claw-shaped digitate process. Socii large, setose, only weakly sclerotized. Small mediocaudal sclerite possibly present as faint sclerotization. Uncus small, forming shallow, triangular, membranous pocket in sclerotized surround.

REMARKS. *C. digitata* is closely allied to *C. brunnescens* but the latter species lacks the cream markings of *digitata*. In *brunnescens* the process from the base of the ventral arm of the tegumen 'T' is blunt, the socii are densely sclerotized anteriorly and the uncus is represented by a medially divided, narrow, transverse, sclerotized crescent supporting the anterior edge of a shallow but broad, trapezoidal, membranous pocket. The specimen described here appears to be that illustrated by Pfitzner & Gaede (1937 : pl. 185, fig. e) as *C. arenosus* although, if so, the illustration is somewhat imaginative. The 'beautiful series' of '*arenosus*' recorded by Pfitzner

& Gaede from the Berlin Museum is now represented only by the specimens described here as *digitata* and *brunnescens*. The description of '*arenosus*' by Pfitzner & Gaede (1937 : 1298) fits true *arenosus* (above) rather than their illustrated specimen. The description and locality (Valdivia) may be based on Butler's (1882 : 24) original description of *arenosus*.

DISTRIBUTION. Chile.

MATERIAL EXAMINED.

Holotype ♂, CHILE (genitalia slide no. H-01; MNHU, Berlin).

Callipielus brunnescens sp. n.

(Pl. 1, fig. 4; Pl. 2, fig. 13; Pl. 4, fig. 21; Pl. 6, fig. 32)

[*Callipielus arenosus* Butler; Pfitzner & Gaede, 1937 : 1298 (partim—1 ♂ only). Misidentification.]

♂. 75 mm. Antenna with 63 angular segments (Pl. 6, fig. 32). Head light greyish brown, scales lighter basally, labial palpus dull brown. Thorax and tegula dark greyish brown, only a little paler posteriorly. Fore wing dull purplish brown with sandy tint to central field, few very small whitish spots ringed with darker brown, light sandy brown markings in anterior half of wing and on costa. Hind wing pale dull brown, termen light sandy yellow, darker spots between veins at termen; base of hind wing and anal angle yellowish brown; fringe of hind wing greyish brown. Legs dull purplish brown, slightly darker above. Epiphysis one-half length of tibia.

♀. Unknown.

GENITALIA ♂ (Pl. 2, fig. 13; Pl. 4, fig. 21). Eighth sternite small, 1·20 × 0·25 mm, distinctly narrowed medially. Ventral lobe of vinculum with densely sclerotized transverse ridge a little beyond one-half anteriorly. Saccus one-half as wide as vinculum. Valve blunt, triangular, densely sclerotized and setose, with shallow depression in outer surface, posterior corner swollen to form a marked hump extending one-quarter length of posterior margin, this hump polished, without setae. Lightly sclerotized region of diaphragma between valves quadrate. Juxta completely fused with tegumen, relatively lightly sclerotized but darker posteriorly, sclerotization extended to caudal lip of intromittent organ but with broad, shallow medial emargination and weakly sclerotized medial line posteriorly; posterior lateral processes of juxta represented by heavily sclerotized lateral humps. Ventral arm of tegumen 'T' fairly broad and elongate, heavily sclerotized; base of ventral arm with densely sclerotized thumb-shaped digitate process. Socii large, setose, heavily sclerotized anteriorly. Mediocaudal sclerite absent. Uncus a medially-divided, narrow, sclerotized transverse crescent supporting anterior edge of shallow but broad trapezoidal membranous pocket. Membrane between socii and uncus with two pairs of groups of small, scattered setae.

REMARKS. *C. brunnescens* is closely allied to *C. digitata* but is more dull-looking and has darker hind wings. For differences in the male genitalia see 'Remarks' for *digitata*. *C. brunnescens* differs from *C. castilloi* in that the latter has a pinkish tint at the base of the hind wing, a silvery white interrupted subterminal line in the fore wing and a shorter, blunter ventral arm of the tegumen 'T', the basal process of which is also shorter and blunter. The eighth sternite of *castilloi* is not constricted medially, the mediocaudal sclerite is present and the uncus is a broad, sclerotized 'U' lying at the base of a shallow pouch.

DISTRIBUTION. Chile.

MATERIAL EXAMINED.

Holotype ♂, CHILE: (*Lossberg*) (genitalia slide no. H-02; MNHU, Berlin).

Callipielus castilloi sp. n.

(Pl. 1, fig. 5; Pl. 3, fig. 14; Pl. 4, fig. 22)

♂. 66 mm. Antenna with angular segments (number unknown). Head dark brown, scales of vertex whitish basally; labial palpus dark brown. Thorax and tegula dark brown, lateral mesothoracic hair paler, with a pinkish tint. Fore wing dark, dull brown with diffuse olivaceous spots beyond cell and towards base and posterior margin; subterminal line whitish, broken. Hind wing dark greyish brown without terminal or subterminal spots; base of hind wing and anal angle yellowish with distinct rose-pink tint at base. Legs dark brown, paler dull brown above. Epiphysis one-half length of tibia.

♀. Unknown.

GENITALIA ♂ (Pl. 3, fig. 14; Pl. 4, fig. 22). Eighth sternite 1·3 × 0·2 mm. Ventral lobe of vinculum with densely sclerotized transverse ridge a little beyond one-half anteriorly. Saccus one-half as wide as vinculum. Valve blunt, triangular, densely sclerotized and setose, with shallow depression in outer surface, posterior corner swollen to form pronounced, angular hump extending one-quarter length of posterior margin, this hump polished, without setae. Region of diaphragma between valves hardly sclerotized. Juxta completely fused with tegumen, sclerotization fairly even and extended almost to lip of intromittent organ but with marked medial emargination and weakly sclerotized medial line; posterior lateral processes of juxta absent. Ventral arm of tegumen 'T' short and broad, base with short, densely sclerotized digitate process. Socii well-sclerotized, setose. Small mediocaudal sclerite present. Uncus broad, U-shaped, in shallow depression in caudal membrane.

REMARKS. *C. castilloi* is very closely allied to *C. brunnescens* but has a pinkish base to the hind wing (see 'Remarks' for *brunnescens*). Of the three species in which a digitate process is formed from the ventral arm of the caudal 'T'-shaped extremity of the tegumen, *castilloi* has the shortest process; it has the most angular development of the protuberance on the posterior corner of the valve and exhibits the largest posterior emargination of the juxta of the three species. In *C. salasi* the juxta has posterior lateral processes, the ventral arm of the tegumen 'T' is reduced and the basal process is represented by a ridge; the ventral lobe of the vinculum has no transverse ridge. The holotype of this species has suffered partial bleaching to a light creamy brown colour either as a result of natural homoeosis or, more probably, chemical action. The apex of each wing is affected, bleaching of the left fore wing extending over most of the wing with the exception of the base of the costa.

DISTRIBUTION. Chile.

MATERIAL EXAMINED.

Holotype ♂, CHILE: Cautin, Temuco, Carillanca Experimental Station, 3.vii.1975 (*Salas*) (genitalia slide no. 13147; BMNH).

Callipielus salasi sp. n.

(Pl. 1, fig. 6; Pl. 3, fig. 15; Pl. 4, fig. 23; Pl. 6, figs 33, 37)

♂. 51–59 mm. Antenna with 48–49 bipectinate segments (Pl. 6, fig. 33). Head dark greyish brown, labial palpus tipped with ochreous scales. Thorax and tegula dark greyish brown. Fore wing dark purplish brown, scales in subcostal field and overlying veins rust-brown, flecked with ochreous cream paler markings; subterminal line of cream spots obsolete anteriorly, terminal spots ochreous ringed with blackish brown. Hind wing greyish brown, veins rust-brown, diffuse paler subterminal flecks and ochreous terminal spots ringed with blackish brown; base of hind wing and anal angle sandy with a slightly orange tint. Legs dark greyish brown, slightly lighter above. Epiphysis one-half length of tibia.

♀. Unknown.

GENITALIA ♂ (Pl. 3, fig. 15; Pl. 4, fig. 23). Eighth sternite represented only by zone of smooth membrane, with or without minute central sclerotized region. Ventral lobe of vinculum with densely sclerotized patch with pair of small dome-shaped protuberances anteriorly. Saccus one-half width of vinculum, shallow. Valve blunt, triangular, heavily sclerotized and setose, with shallow depression in outer surface, posterior corner swollen to form pronounced hump extending one-half length of posterior margin, this hump polished, without setae. Region of diaphragma between valves hardly sclerotized. Juxta completely fused with tegumen, much darker in caudal half, sclerotization extended to lip of intromittent organ; posterior lateral processes of juxta densely sclerotized, conical, tips sharp or blunt. Ventral arm of tegumen 'T' reduced, hardly sclerotized, base forming densely sclerotized, narrow ridge with small, blunt, thorn-like process at tip. Socii well-sclerotized, almost fused with square dorsal arms of tegumen 'T', anterior half setose. Small mediocaudal sclerite present or absent. Uncus a wide, trapezoidal, shallow pocket with moderate sclerotization.

REMARKS. *C. salasi* is a rusty-looking species, the only *Callipielus* with bipectinate antennae. It differs from the *C. digitata-brunnescens-castilloi* species-group in not possessing a stout digitate process from the ventral arm of the tegumen and in having almost entirely lost the eighth sternite. *C. izquierdoi* is smaller than *salasi* (the third smallest species of the genus) and the hind wing of the former species is dull orange. The juxta of *izquierdoi* is deeply divided medially and is only fused with the tegumen anteriorly.

DISTRIBUTION. Chile.

MATERIAL EXAMINED.

Holotype ♂, CHILE: Cautin, Temuco, Carillanca Experimental Station, 20.v.1975 (*Salas*) (genitalia slide no. 13160; BMNH).

Paratypes. 2 ♂, data as holotype; 1 ♂, data as holotype but 22.v.1975 (*Castillo*) (genitalia slide nos 13146, 13152, 13155; BMNH).

Callipielus izquierdoi (Ureta) comb. n.

(Pl. 1, fig. 7; Pl. 3, fig. 16; Pl. 4, fig. 24; Pl. 5, fig. 29; Pl. 6, fig. 34)

Stachyocera izquierdoi Ureta, 1957, *Boln Mus. nac. Hist. nat. Chile* **27**(2) : 159, figs 1, 2, pl. fig. 10. Holotype ♂, CHILE: Caramávida, Cordillera de Nahuelbuta, 1000 m, 5–10.ii.1953 (*Peña*) (MNS, Santiago) [examined].

♂. 39–43 mm. Antenna with 44 angular segments (Pl. 6, fig. 34). Head dull brown, labial palpus tipped with paler scales. Thorax and tegula dull brown flecked with white, metathorax clothed with dull orange hairs. Fore wing dull brown patterned with small, bold, white spots, each edged with black; conspicuous broken white subterminal line; conspicuous black mark at base of posterior margin. Hind wing dull orange tinted with greyish brown in distal half, some diffuse paler spots towards margin. Legs dull brown with some flecks of white. Epiphysis one-half length of tibia.

♀. 52 mm. Antenna with 43 angular segments. Somewhat paler than ♂ with, apparently, less pattern but specimen very damaged.

Genitalia ♂ (Pl. 3, fig. 16; Pl. 4, fig. 24). Eighth sternite apparently absent. Ventral lobe of vinculum with medial and transverse ridges forming inverted 'T', setose in posterior half. Saccus less than one-half width of vinculum, semicircular. Valve blunt, kidney-shaped, heavily sclerotized and setose in distal half, with shallow depression in outer surface. Lightly sclerotized region of diaphragma between valves roughly square but ill-defined. Juxta fused with tegumen only at anterior corners, deeply emarginate almost to edge of pinched tube at base of intromittent organ; posterior lateral processes of juxta conical, not more densely sclerotized than rest of juxta. Ventral arm of tegumen 'T' very short, forming flattened, dark, tooth-like process. Socii lightly sclerotized, setose, fused with dorsal arms of tegumen 'T' and with each other. Mediocaudal sclerite absent. Uncus absent.

Genitalia ♀ (Pl. 5, fig. 29). Ninth sternite small (0·9 × 0·6 mm), tips rounded, 'm'-shaped. Papillae anales large, quadrangular, not overlapping ninth sternite.

Remarks. The fore wing pattern of this species, with a conspicuous black streak at the base of the posterior margin, is distinctive. The male of *izquierdoi* is the smallest of the genus. The male genitalia exhibit reduction of the caudal arms of the tegumen and deep and characteristic emargination of the juxta, features which separate *izquierdoi* from other *Callipielus* species. Fusion of the socii and loss of the uncus are also to be found in *C. argentata* but in the latter species the socii are much broader and the caudal arms of the tegumen 'T' are extremely elongate. The allotype of *izquierdoi* is so worn as to defy positive determination but it is probably correctly placed as it was collected with males of *izquierdoi* in a locality from which, apparently, no other *Callipielus* species were collected.

Distribution. Chile.

Material examined.

Allotype ♀, data as holotype (genitalia slide no. 1049 [Robinson]; MNS, Santiago).

Chile: 2 ♂, Cautin, Temuco, Carillanca Experimental Station, 1–3.iii.1975 (*Salas*), 18.iii.1975 (*Castillo*) (genitalia slide nos 13150, 13151; BMNH).

Callipielus argentata Ureta

(Pl. 1, fig. 8; Pl. 3, fig. 17; Pl. 4, fig. 25; Pl. 6, fig. 35)

Callipielus argentata Ureta, 1957, *Boln Mus. nac. Hist. nat. Chile* **27**(2) : 162, fig. 3. Holotype ♂, Chile: Laguna del Maule, 1800 m, 31.iii.1957 (*Marchant*) (MNS, Santiago) [examined].

♂. 40–48 mm. Antenna with 38–43 angular segments (Pl. 6, fig. 35). Head bright tawny ochre, labial palpus slightly darker. Thorax and tegula bright tawny ochre, paler ventrally.

Fore wing ochreous mixed with medium brown, darker in basal half, patterned with bold silver markings edged with fine medium brown lines. Hind wing bright ochreous, without subterminal maculae. Legs bright tawny ochre, some purplish brown scales scattered on upper surface. Epiphysis one-half length of tibia.

♀. Unknown.

GENITALIA ♂ (Pl. 3, fig. 17; Pl. 4, fig. 25). Eighth sternite represented only by zone of smooth membrane with pair of small, weakly sclerotized oval patches. Ventral lobe of vinculum with sharply pointed medial spine. Saccus slightly less than one-half width of vinculum, rather shallow. Valve short and blunt, angled inwardly and anteriorly, densely setose at tip. Region of diaphragma between valves only very lightly sclerotized. Juxta completely fused with tegumen, very broad, only weakly sclerotized medially but sclerotization extended to tip of intromittent organ; base of juxta only slightly pinched, so not forming complete tube; posterior lateral processes of juxta absent. Ventral arm of tegumen 'T' very much elongated and narrow, the two arms forming a 'spout' overlapping anterior lip of intromittent organ (before dissection); dorsal arms of tegumen 'T' not developed. Socii well-sclerotized, fused medially, uniformly setose. Mediocaudal sclerite absent. Uncus absent.

REMARKS. *C. argentata* has a particularly bright and characteristic wing pattern which differentiates it from all other known *Callipielus* species. It differs from *C. izquierdoi* in having a much paler fore wing pattern. The male genitalia differ from those of all other known *Callipielus* species in having a medial spine on the ventral lobe of the vinculum and in having the valve turned inwards and anteriorly and somewhat flattened. In lacking both mediocaudal sclerite and uncus, *argentata* is similar to *izquierdoi* but in the latter species the fused socii are not nearly as broad as in *argentata* and the ventral (caudal) arm of the tegumen 'T' is reduced to a squarish, tooth-like process. Ureta's 'allotype' of *argentata* is, unfortunately, a male.

DISTRIBUTION. Chile.

MATERIAL EXAMINED.

Paratypes 1 ♂, data as holotype (genitalia slide no. 1052 [Robinson]; MNS, Santiago); 1 ♂ 'allotype', data as holotype (MNS, Santiago).

Callipielus sp. indet.

(Pl. 2, fig. 9; Pl. 5, fig. 27; Pl. 6, fig. 36)

♂. Unknown.

♀. 60–68 mm. Antenna with 45 barrel-shaped segments (Pl. 6, fig. 36). Head dull greyish brown, vertex paler. Thorax and tegula dull greyish brown, paler posteriorly. Fore wing dull fuscous, whitish markings with brown margins in cell, traces of whitish subterminal spots with dark margins (all specimens very worn). Hind wing dull fuscous, brownish on veins. Fringes of both wings ochreous. Legs dull greyish brown. Epiphysis one-quarter length of tibia.

GENITALIA ♀ (Pl. 5, fig. 27). Ninth sternite small (1·2–1·6 × 0·8–0·9 mm). Papillae anales quadrangular, not overlapping ninth sternite.

REMARKS. It is doubtful if the specimens described here can be associated with

any of the named *Callipielus* species. The epiphysis is much shorter in these specimens than in other *Callipielus* in which it is half the length of the tibia. They differ from *C. arenosus* in the shape of the papillae anales which do not overlap the smaller ninth sternite.

DISTRIBUTION. Chile.

MATERIAL EXAMINED.

CHILE: 3 ♀, Cautin, Temuco, Carillanca Experimental Station, 10–11.v.1975 (*Salas*), 19.v.1975 (*Castillo*), 20.v.1975 (*Salas*) (genitalia slide nos 13148, 13149, 13153; BMNH).

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INDEX

Synonyms are in *italics*; principal references are in **bold.**

arenosus Butler, 109, 110, 111, **112**, 114, 115, 120
argentata Ureta, 110, 111, **118**

brunnescens sp. n., 110, 112, 114, **115**, 116

Callipielus Butler, **110**
castilloi sp. n., 105, 110, 112, 115, **116**
Charagia Walker, 105
chiliensis Viette, 103, 110, 111, **113**

Dalaca Walker, 105, 106
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Leto Hübner, 105
leukogramma Bryk, 112
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salasi sp. n., 110, 111, 116, **117**
Stachyocera Ureta, 110, 117

Zenophassus Tindale, 108

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PLATE 1

FIG. 1. *Callipielus arenosus* Butler, ♂, Chile: Tierra del Fuego.
FIG. 2. *C. chiliensis* Viette, ♂, Chile [image reversed].
FIG. 3. *C. digitata* sp. n., ♂ holotype, Chile.
FIG. 4. *C. brunnescens* sp. n., ♂ holotype, Chile.
FIG. 5. *C. castilloi* sp. n., ♂ holotype, Chile: Temuco.
FIG. 6. *C. salasi* sp. n., ♂ paratype, Chile: Temuco [image reversed].
FIG. 7. *C. izquierdoi* (Ureta), ♂, Chile: Temuco.
FIG. 8. *C. argentata* Ureta, ♂ paratype, Chile: Laguna del Maule.

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PLATE 2

FIG. 9. *Callipielus* sp. indet., ♀, Chile: Temuco.

Male genitalia

FIG. 10. *Callipielus arenosus* Butler [holotype of *leukogramma*], Argentina.
FIG. 11. *C. chiliensis* Viette, Chile.
FIG. 12. *C. digitata* sp. n., holotype, Chile.
FIG. 13. *C. brunnescens* sp. n., holotype, Chile.

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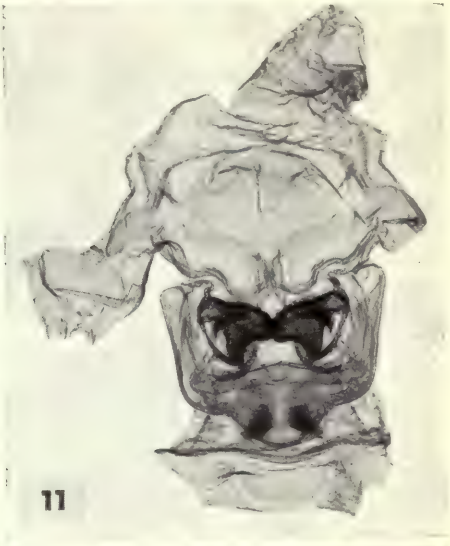
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PLATE 3

Male genitalia

FIG. 14. *Callipielus castilloi* sp. n., holotype, Chile.
FIG. 15. *C. salasi* sp. n., holotype, Chile.
FIG. 16. *C. izquierdoi* (Ureta), Chile.
FIG. 17. *C. argentata* Ureta, paratype, Chile.

Caudal sclerites of male genitalia

FIG. 18. *C. arenosus* Butler [holotype of *leukogramma*], Argentina.
FIG. 19. *C. chiliensis* Viette, Chile.

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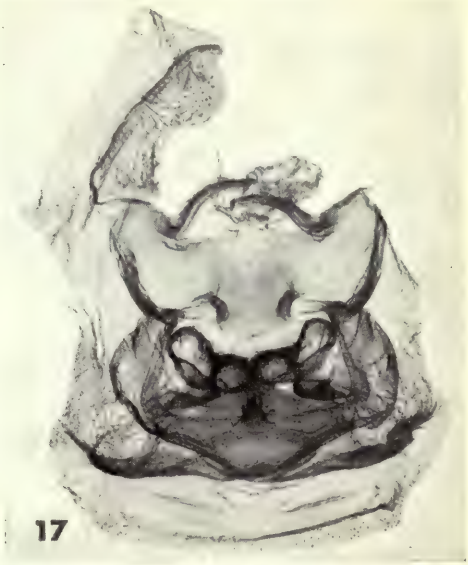
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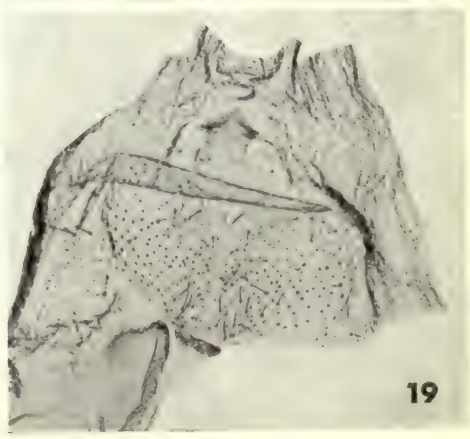
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PLATE 4

Caudal sclerites of male genitalia

FIG. 20. *Callipielus digitata* sp. n., holotype, Chile.
FIG. 21. *C. brunnescens* sp. n., holotype, Chile.
FIG. 22. *C. castilloi* sp. n., holotype, Chile [uncus separate].
FIG. 23. *C. salasi* sp. n., holotype, Chile [u = uncus, s = socius].
FIG. 24. *C. izquierdoi* (Ureta), Chile.
FIG. 25. *C. argentata* Ureta, paratype, Chile.

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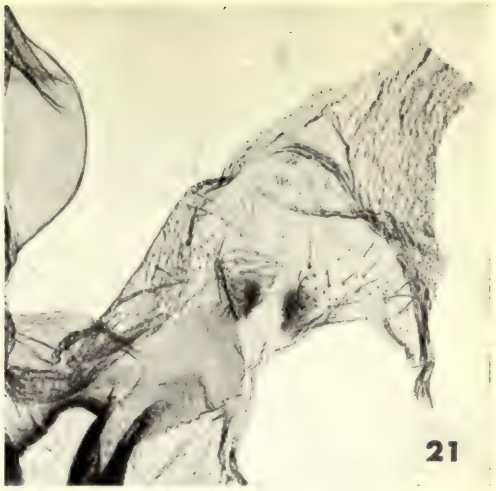
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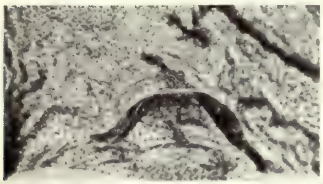

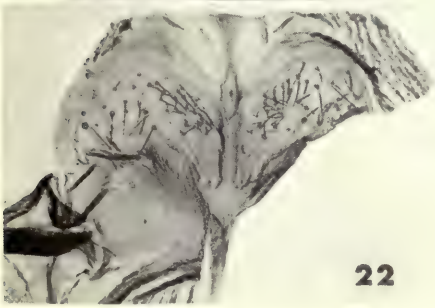
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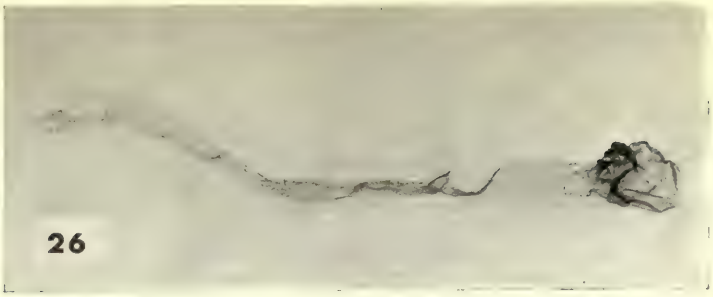
PLATE 5

Aedeagus of male

FIG. 26. *Callipielus arenosus* Butler [holotype of *leukogramma*], Argentina.

Female genitalia

FIG. 27. *Callipielus* sp. indet., Chile.
FIG. 28. *C. arenosus* Butler [paratype of *leukogramma*], Argentina.
FIG. 29. *C. izquierdoi* (Ureta), allotype, Chile.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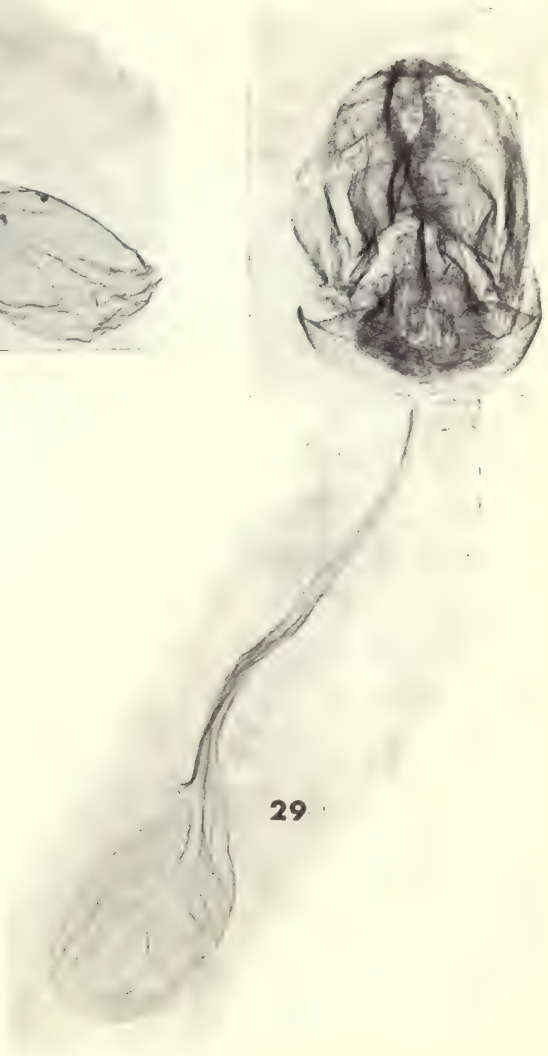
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PLATE 6

Antennal segments

FIG. 30. *Callipielus arenosus* Butler, ♂ lectotype, Chile.
FIG. 31. *C. digitata* sp. n., ♂ holotype, Chile.
FIG. 32. *C. brunnescens* sp. n., ♂ holotype, Chile.
FIG. 33. *C. salasi* sp. n., ♂ paratype, Chile.
FIG. 34. *C. izquierdoi* (Ureta), ♂, Chile.
FIG. 35. *C. argentata* Ureta, ♂ paratype, Chile.
FIG. 36. *Callipielus* sp. indet., ♀, Chile.

Labium and labial palpus

FIG. 37. *C. salasi* sp. n., ♂ paratype, Chile.

Fore leg

FIG. 38. *C. digitata* sp. n., ♂ holotype, Chile.

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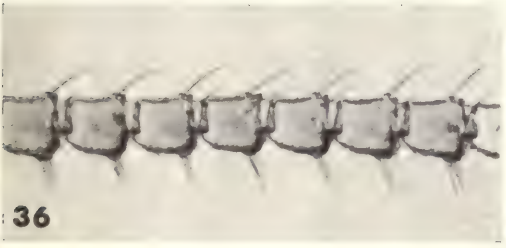
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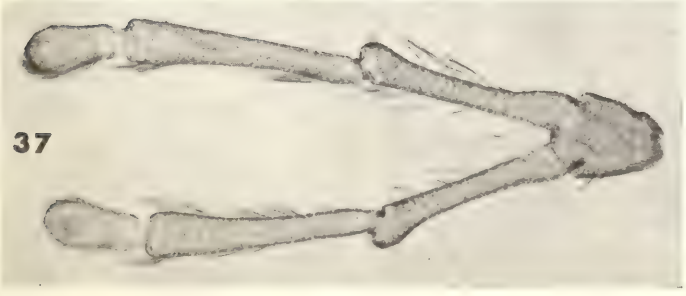
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